Hydrology Technical Study
Tentative Tract 17423

City of Costa Mesa, Orange County, CA

Prepared for
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June 13, 2011
RBF JN 10-108158

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1 INTRODUCTION

This study addresses the hydrologic impacts associated with the proposed development of Tentative Tract 17423 (project), located in the City of Costa Mesa, California. The City of Costa Mesa is located in the County of Orange; refer to Exhibit 1: Regional Vicinity Map. The project site is at 2626 Harbor Boulevard at the corner for Harbor Boulevard and Merrimac Way; refer to Exhibit 2: Local Vicinity Map.

The project consists of the construction of thirty-three (33) residential lots, one (1) private street, and seven (7) open space lots on approximately 3.71-acres.

This report is a technical engineering study/evaluation to be used solely to support the environmental document for the project on issues related to drainage, and surface hydrology. The level of analysis prepared is compatible with the level of planning information available.

All assessments and technical analysis in this report are in compliance with the local drainage policies and requirements for the City of Costa Mesa, Orange County, and the California Environmental Quality Act (CEQA) of 1970, as amended. The hydrology analysis has been prepared at a preliminary engineering level based upon the details of the available information for an environmental document.

1.1 History/Background

The project site is located in a highly urbanized coastal plain of Orange County. The site is south of the Santa Ana River, and is located within the Santa Ana Delhi Watershed which s tributary to the Upper Newport Bay.

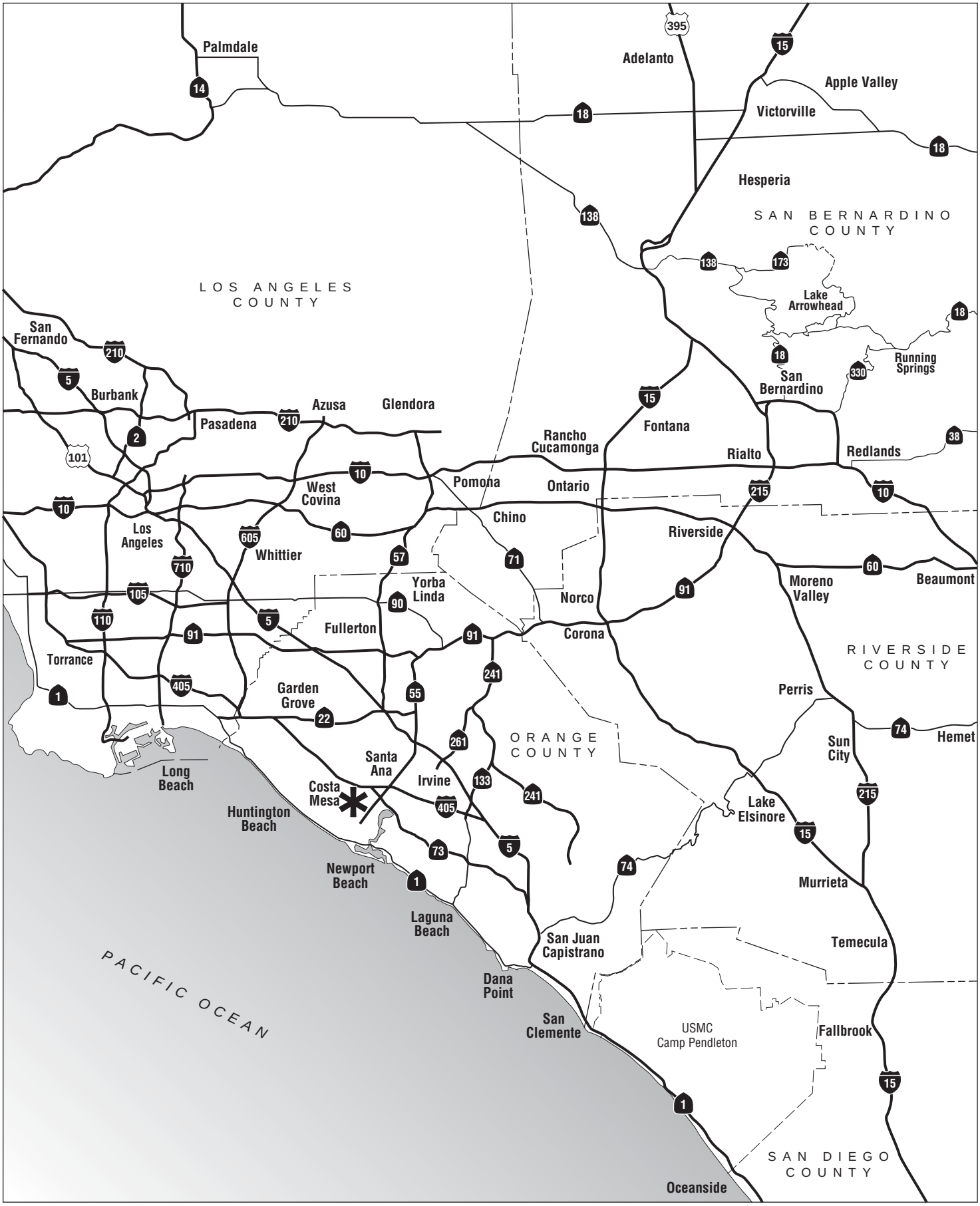
1.2 Definition of Level of Significance

The purpose of this technical evaluation is to determine the impact of the proposed residential development on hydrology, and floodplains within the study area. Should the analysis determine that the proposed project significantly impacts the drainage patterns, hydrology, or floodplains, appropriate mitigation will be identified to minimize the project impacts to less than significant levels.

1.2.1 Flood Control Criteria

Federal, state, and local drainage laws and regulations govern the evaluation of impacts to surface water drainage. For this evaluation, impacts to surface water drainage would be considered significant if the project alters the drainage patterns of the site, resulting in substantial erosion, siltation, or increased run-off that would result in increased flooding in downstream facilities.

Exhibit 1: Regional Vicinity Map



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0 5 11 miles
APPROXIMATE

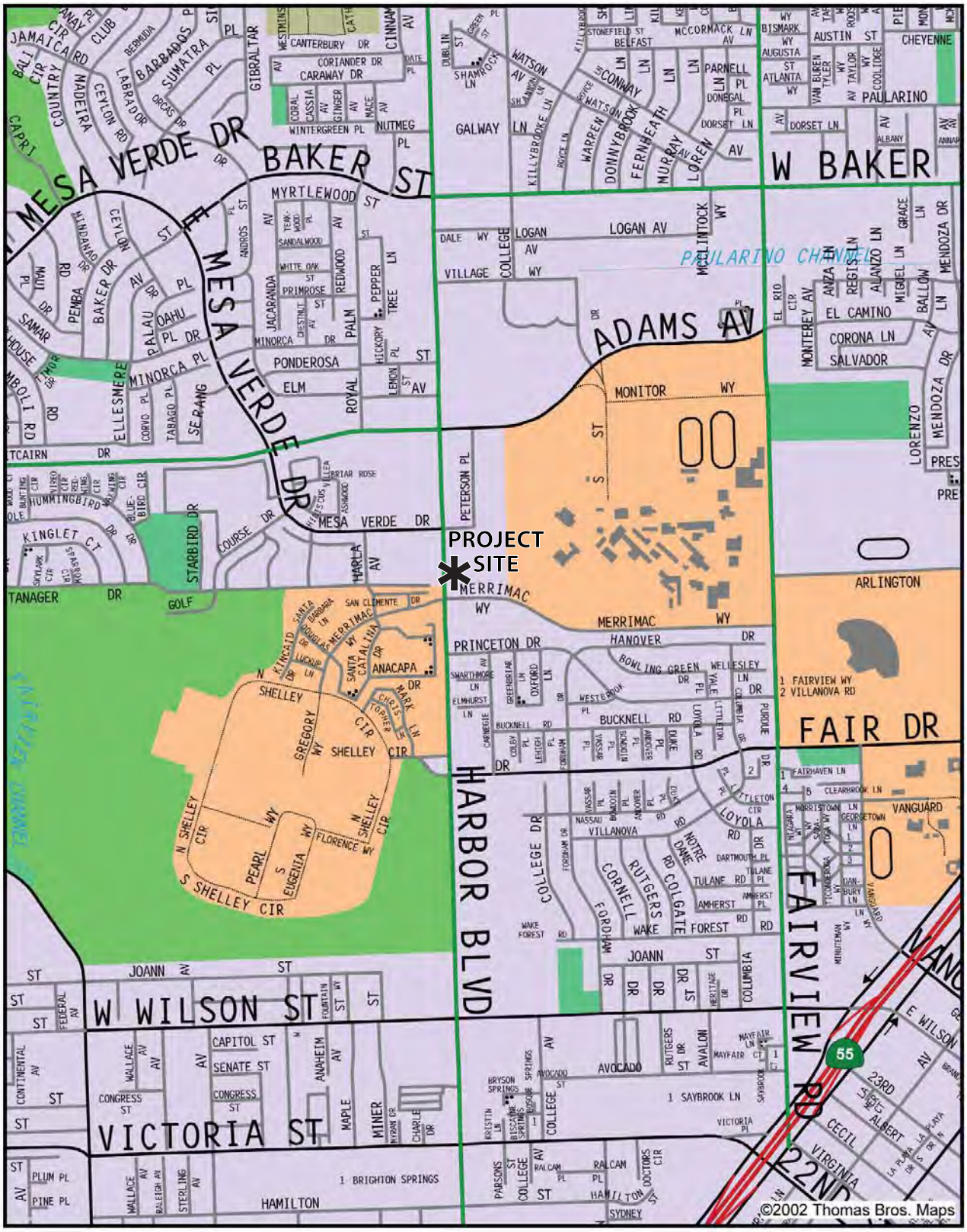
6/08/11 JN 10-108150

2626 HARBOR BOULEVARD
INITIAL STUDY/MITIGATED NEGATIVE DECLARATION

Regional Vicinity

Exhibit 1

Exhibit 2: Local Vicinity Map



Source: Thomas Brothers Maps, 2002.

NOT TO SCALE

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6/08/11 JN 10-108150

2626 HARBOR BOULEVARD
INITIAL STUDY/MITIGATED NEGATIVE DECLARATION

Local Vicinity

Exhibit 2

2 EXISTING CONDITION

This section is divided into three sub-sections: 1) existing land use; 2) hydrology; and 3) floodplains. Each sub-section describes different aspects of the existing condition of the project site.

2.1 Existing Land Use

The project site was formerly a Lincoln Mercury car dealership. Two vacant structures associated with the previous auto dealership are located on the project site. The site is comprised entirely of impervious surfaces primarily associated with the former dealership's parking lot. The project site is largely void of vegetation with the exception of a few ornamental trees along the Harbor Boulevard frontage and along the project site's western boundary.

Commercial uses (car dealerships) and a two-story multi-family housing development are located along the project site's northern boundary. Car ports and associated parking from these uses immediately abut the project. East of the project site is a three-story multi-family residential use. The development and associated surface parking, including carports, immediately abut the project.

Merrimac Way borders the project site to the immediate south. Beyond Merrimac Way is an auto dealership with associated mechanics facilities and surface parking. Multi-family residential uses with associated surface parking are also located to the south beyond Merrimac Way. Harbor Boulevard bounds the project site to the west. Beyond Harbor Boulevard is a multi-family residential development as well as Local Business (C1) uses.

For the existing hydrology condition analysis, the project site was considered commercial land use with a percent impervious of 90%.

2.2 Hydrology

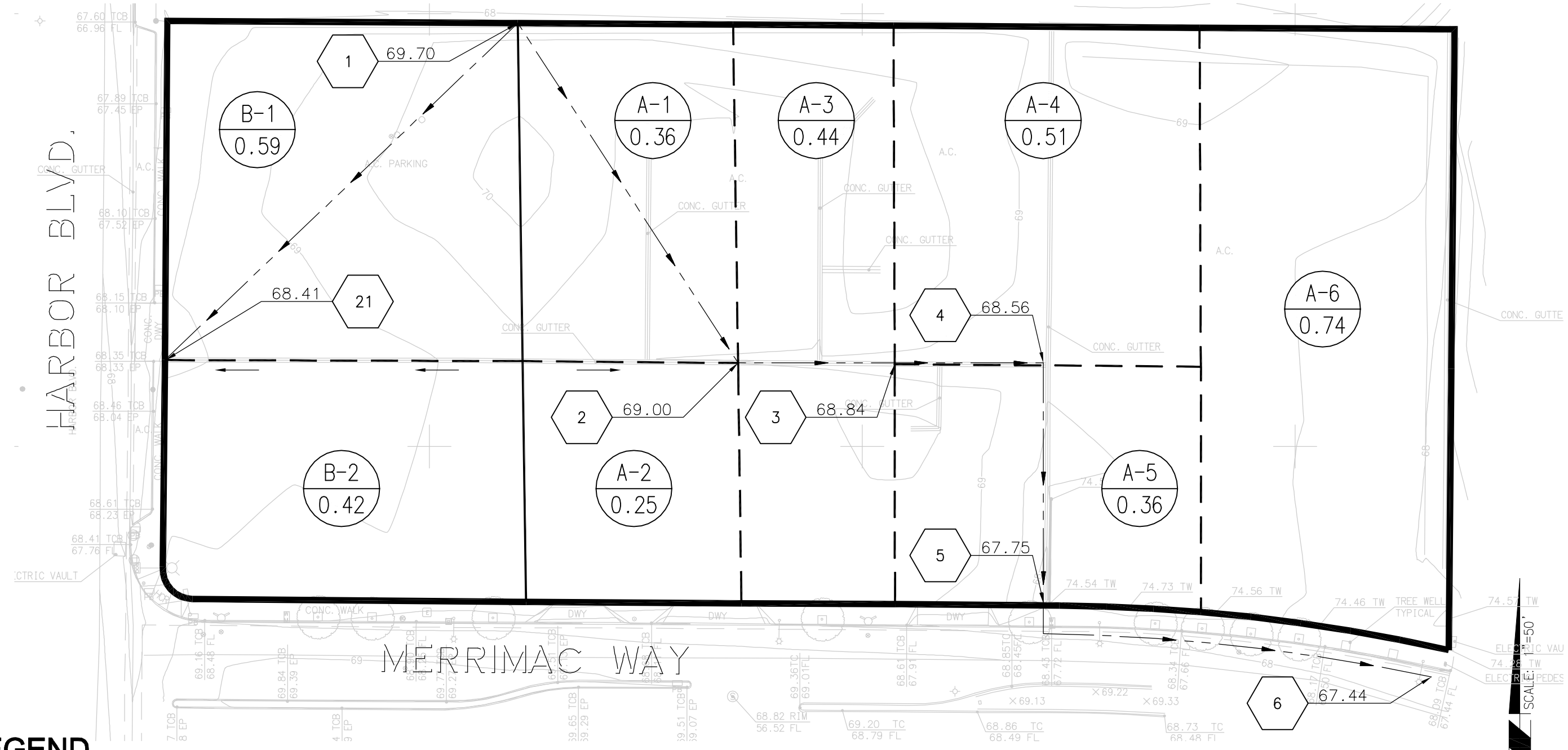
This sub-section describes the existing condition technical analysis. The sub-section is broken into two parts: Watershed Description and Analysis and Results.

2.2.1 Watershed Description

The existing watershed is broken up into two sub-watersheds: the area draining to Harbor Boulevard and the area draining to Merrimac Way, refer to Exhibit 3: Existing Conditions Hydrology Map. The runoff tributary to Harbor Boulevard (Watershed B) sheet flows from the parking lot to a driveway which outlets the flow onto Harbor Boulevard which eventually makes its way northeastword to F03 (Paularino Channel) which is eventually tributary to the Santa Ana Delhi Channel.

The runoff tributary to Merrimac sheet flows into a ribbon gutter, which eventually discharges to Merrimac Way through a driveway. The flow then continues eastward on Merrimac Way until it enters a catch basin which is tributary to an existing 4.5'Hx8'W RCB. The RCB is eventually tributary to E03 upstream of Pinecreek Drive.

Exhibit 3: Existing Hydrology Map



LEGEND

- DRAINAGE BOUNDARY
- SUBAREA BOUNDARY
- FLOW PATH
- B-12 / 11.3 — SUBAREA DESIGNATION / AREA (ACRES)
- 1000 — HYDROLOGY NODE

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TENTATIVE TR. 17423
EXISTING HYDROLOGY
EXHIBIT 3

SHEET 1 OF 1

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2.2.2 Analysis and Results

For this study, the existing site was delineated based on the topography. The areas were calculated and a rational method hydrology analysis was completed in accordance with Orange County Hydrology Manual Requirements. See Table 2-1 for Existing Condition Results.

Table 2-1: Existing Condition Hydrology Summary

Sub-Watershed	Node	Area (acres)	Total 10-Year Flow Rate Exiting the Site (cfs)	Total 25-Year Flow Rate Exiting the Site (cfs)	Total 100-Year Flow Rate Exiting the Site (cfs)
A	**6**	2.67	6.12	7.37	9.53
B	**21**	1.01	2.78	3.48	4.46

For the water quality Hydrologic Conditions of Concern Analysis, a 2-year storm was analyzed for runoff flowrate, volume and time of concentration for the overall site**.**

Table 2-2: Existing Condition 2-Year Analysis Summary

Flowrate (cfs)	Volume (Acre-feet)	Time of Concentration (Minutes)
4.82	0.45	11.72

2.3 Floodplains

The published Flood Insurance Rate Maps (FIRMs) for the project site are included on Community Panel No. 06059C0266J. Refer to Exhibit 4: FEMA FIRM Map, for a location of mapped floodplains. The project is located within the FEMA Zone X (Other Flood Areas) designation. FEMA Flood Zone X (Other Flood Areas) designated areas are outside of the 0.2% annual chance floodplain. FEMA Flood Zone X is a moderate to low risk flooding area where flood insurance is available to property owners but not required.

Exhibit 4: FEMA FIRM Map

ional Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

50 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0266J

FIRM

FLOOD INSURANCE RATE MAP

ORANGE COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 266 OF 539

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COSTA MESA, CITY OF	060216	0266	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06059C0266J

MAP REVISED
DECEMBER 3, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EXHIBIT 4: FEMA FIRM MAP

3 PROPOSED CONDITIONS

This section describes the proposed condition technical analysis. The section is broken into three sub-sections: 1) proposed land use; 2) hydrology; and 3) floodplains. Each sub-section describes different aspects of the proposed condition.

3.1 Proposed Land Use

For the proposed condition, the project site was considered one land use: 8-10 dwelling units per acres. The percent impervious for each land use was per the *County of Los Orange Hydrology Manual*; refer to Exhibit 5: Proposed Conditions Hydrology Map and Table 3-1: Proposed Land Use Summary.

Table 3-1: Proposed Land Use Summary

Sub-Watershed	Node	Total Area	
		(ac)	% Impervious
C	**50**	3.6	60%

3.2 Hydrology

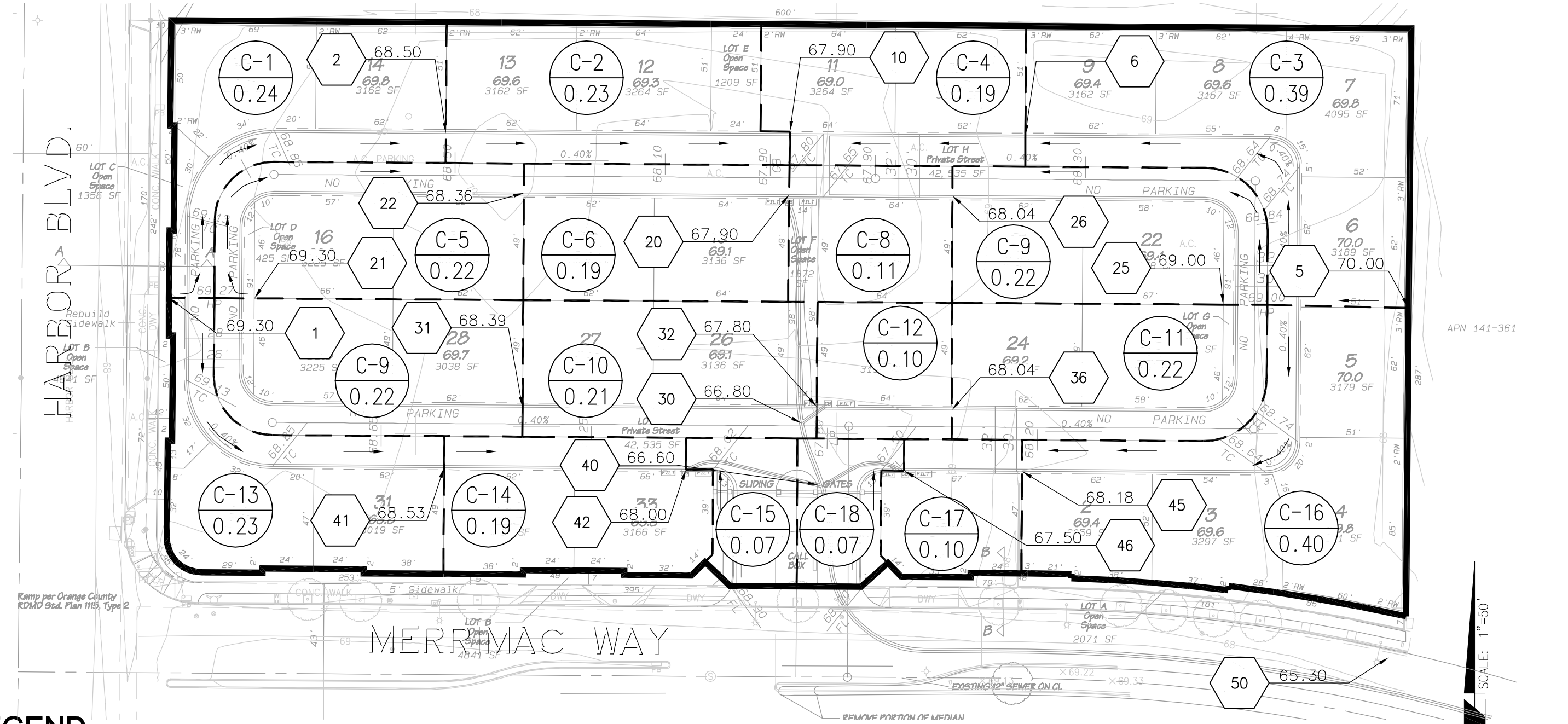
This sub-section is divided into two parts: 1) Watershed Description and 2) Analysis and Results.

3.2.1 Watershed Description

The proposed watershed is one Sub-watershed that is tributary to a new proposed storm drain pipe that will connect the new onsite storm drain directly to the existing 4.5'Hx8'W box under Merrimac Way (existing discharge point of Existing Condition Watershed A). The watershed tributary to the existing 4.5'Hx8'W box has increased slightly due to the combination of the existing Watershed A and B in the proposed condition (Watershed C). However, the percent impervious has been reduced from 90% to 60%.

The onsite storm drain consists of gutters, catch basins and storm drain to capture the development flow and direct it to the new storm drain extension in Merrimac Way.

Exhibit 5: Proposed Condition Hydrology Map



LEGEND

- DRAINAGE BOUNDARY
- SUBAREA BOUNDARY
- FLOW PATH
- B-12 / 11.3 — SUBAREA DESIGNATION / AREA (ACRES)
- 1000 — HYDROLOGY NODE

50 25 0 50 100 150

SCALE: 1"=50'

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TENTATIVE TR. 17423
PROPOSED HYDROLOGY
EXHIBIT 5

SHEET 1 OF 1

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3.2.2 Analysis and Results

A proposed conditions hydrology analysis was completed for the 10-, 25-, and 100-year storms for comparison against existing conditions. The proposed condition hydrology was calculated using the Orange County Rational Method Hydrology; refer to Table 3-2: Proposed Hydrology Analysis Summary.

Table 3-2: Proposed Hydrology Analysis Summary

Sub-Watershed	Node	Area (acres)	Total 10-year Flow Rate (cfs)	Total 25-year Flow Rate (cfs)	Total 100-year Flowrate (cfs)
C	**50**	3.60	8.16	9.83	12.68

For the water quality Hydrologic Conditions of Concern Analysis, a 2-year storm was analyzed for runoff flowrate, volume and time of concentration for the overall site.

Table 3-1: Proposed Condition 2-Year Analysis Summary

Flowrate (cfs)	Volume (Acre-feet)	Time of Concentration (Minutes)
4.34	0.27	12.53

3.3 Floodplains

Since the project area is in a Zone X floodplain, which is not a special flood hazard area, no changes to the floodplain will occur as part of the proposed project.

4 IMPACTS

This section describes the proposed condition impact to the watershed. The section is broken into four sub-sections: 1) drainage; 2) hydrology: and 3) floodplains. Each sub-section describes the different impacts caused by the proposed condition.

4.1 Drainage

The proposed project would alter drainage patterns due to on-site grading; refer to Table 4-1: Comparison of Drainage Area Impacts.

Table 4-1: Comparison of Drainage Area Impacts

Sub-Watershed	Existing Conditions		Proposed Conditions		Comparison	
	Area (ac)	% Impervious	Area (ac)	% Impervious	Δ Area (ac)	Δ %Impervious
A/C	2.67	90	3.68	60	1.07	-30%
B	1.01	90	0	0	-1.07	

4.2 Hydrology

The results of the impact analysis show that the change in drainage patterns onsite have caused a minor increase in flow to the proposed storm drain in Merrimac. However, overall the flow from the site is decreased to the Paularino Channel. Table 4-2: Comparison of Hydrology shows the results.

Table 4-2: Comparison Hydrology

Sub-Watershed	10-Year Storm			25-Year Storm			100-Year Storm		
	Existing Flowrate (cfs)	Proposed Flowrate (cfs)	Δ Flowrate	Existing Flowrate (cfs)	Proposed Flowrate (cfs)	Δ Flowrate	Existing Flowrate (cfs)	Proposed Flowrate (cfs)	Δ Flowrate
A/C	6.12	8.16	+2.04	7.37	9.83	+2.46	9.53	12.68	+3.15
B	2.78	0	-2.78	3.48	0	-3.46	4.46	0	-4.46
Total	8.90	8.16	-0.74	10.85	9.83	-1.0	13.99	12.68	-1.31

The results of the 2-year impact analysis show decreases in flowrate and volume, with an increase in Time of Concentration. The proposed land use would bring the hydrology of the 3.68 acres closer to a natural condition due to the increase in pervious area. The impacts of this change on the Santa Ana Delhi will be negligible as the project only represents 0.033% (3.68/11,071 acres) of the watershed.

Table 4-3: 2-year Comparison Hydrology

Parameter	Existing	Proposed	Δ
Flowrate (cfs)	4.82	4.34	-0.48
Volume (acre-feet)	0.45	0.27	-.0.18
Time of Concentration (min)	11.72	12.53	+0.81

4.3 Floodplains

There are no mapped special flood hazard areas on-site; therefore, there is no impact.

5 PROPOSED MITIGATION

This section describes the mitigation measures required to prevent the proposed project impacts to the watershed. The section is broken into four sub-sections: 1) drainage; 2) hydrology; and 3) floodplains.

5.1 Drainage

Mitigation measures for drainage are listed below:

- Prepare a detailed hydrology study to accurately identify project impacts.
- A new storm drain between the project site and the existing 4.5'H x8W RCB shall be analyzed, designed and constructed.
- All storm drain facilities shall be designed for 25-year storm event protection.
- All storm drain in public right-of-way shall be a minimum of 24 inches by City of Costa Mesa requirements and will be designed in accordance with the Orange County Local Drainage Manual including a minimum spacing between manholes of 300 feet.

Completion of these drainage mitigation measures would reduce impacts to a less than significant level.

5.2 Hydrology

Refer to mitigation measures outlines in Section 5.1. Completion of these mitigation measures would reduce flooding impacts to less than significant level.

5.3 Floodplain

No mitigation is required.

6 REFERENCES

Orange County Department of Public Works. *Orange County Hydrology Manual.* October 1986.

County of Orange. *Hydrology Report Santa Ana-Delhi Channel - Facility F01Entire Draiange System.* January 1996.

APPENDIX A: EXISTING CONDITION 10-, 25- AND 100-YEAR ANALYSIS

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************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
          (c) Copyright 1983-2001 Advanced Engineering Software (aes)
              Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\EX-A-10.DAT
  TIME/DATE OF STUDY: 15:37 06/09/2011
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     10.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  ELEVATION DATA: UPSTREAM(FEET) =      69.70  DOWNSTREAM(FEET) =      69.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     7.484
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.222
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.36      0.20        0.10    75    7.48
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =       1.04
  TOTAL AREA(ACRES) =       0.36   PEAK FLOW RATE(CFS) =       1.04
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************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       2.00 IS CODE =  81
------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
  MAINLINE Tc(MIN) =    7.48
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.225
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN
  COMMERCIAL                 D        0.25      0.20        0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.25      SUBAREA RUNOFF(CFS) =     0.72
  EFFECTIVE AREA(ACRES) =     0.61    AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =      0.61       PEAK FLOW RATE(CFS) =       1.76

************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       3.00 IS CODE =  91
------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
========================================================================
  UPSTREAM NODE ELEVATION(FEET) =      69.00
  DOWNSTREAM NODE ELEVATION(FEET) =      68.84
  CHANNEL LENGTH THRU SUBAREA(FEET) =     65.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.375   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =    0.70
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.143
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN
  COMMERCIAL                 D        0.44      0.20        0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      2.38
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    2.65
  AVERAGE FLOW DEPTH(FEET) =    0.62   FLOOD WIDTH(FEET) =     3.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =    0.41   Tc(MIN.) =    7.89
  SUBAREA AREA(ACRES) =     0.44      SUBAREA RUNOFF(CFS) =     1.24
  EFFECTIVE AREA(ACRES) =     1.05    AREA-AVERAGED Fm(INCH/HR) =    0.02
  AREA-AVERAGED Fp(INCH/HR) =    0.20  AREA-AVERAGED Ap =    0.10
  TOTAL AREA(ACRES) =     1.05        PEAK FLOW RATE(CFS) =       2.95

         NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL
         DEPTH EQUAL TO [GUTTER-HIKE + PAVEMENT LIP]

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.62   FLOOD WIDTH(FEET) =     3.00
  FLOW VELOCITY(FEET/SEC.) =    2.65   DEPTH*VELOCITY(FT*FT/SEC) =    1.66
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE       3.00 =    250.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE       3.00 TO NODE       4.00 IS CODE =  51
------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =      68.84  DOWNSTREAM(FEET) =      68.56
  CHANNEL LENGTH THRU SUBAREA(FEET) =     70.00   CHANNEL SLOPE =  0.0040
  CHANNEL BASE(FEET) =     0.00   "Z" FACTOR =    6.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =    0.50
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 CHANNEL FLOW THRU SUBAREA(CFS) =      2.95
 FLOW VELOCITY(FEET/SEC) =   2.32   FLOW DEPTH(FEET) =   0.46
 TRAVEL TIME(MIN.) =   0.50   Tc(MIN.) =   8.40
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =   320.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =   8.40
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.044
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.51      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.51     SUBAREA RUNOFF(CFS) =     1.39
 EFFECTIVE AREA(ACRES) =     1.56   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     1.56       PEAK FLOW RATE(CFS) =       4.25

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     68.56
 DOWNSTREAM NODE ELEVATION(FEET) =     67.75
 CHANNEL LENGTH THRU SUBAREA(FEET) =   110.00
 "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.250
 PAVEMENT LIP(FEET) =  0.375   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
 MAXIMUM DEPTH(FEET) =   0.70
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.966
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.36      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      4.72
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.58
 AVERAGE FLOW DEPTH(FEET) =   0.62   FLOOD WIDTH(FEET) =    3.00
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.40   Tc(MIN.) =   8.80
 SUBAREA AREA(ACRES) =     0.36     SUBAREA RUNOFF(CFS) =     0.95
 EFFECTIVE AREA(ACRES) =     1.92   AREA-AVERAGED Fm(INCH/HR) =   0.02
 AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
 TOTAL AREA(ACRES) =     1.92       PEAK FLOW RATE(CFS) =       5.09

        NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL
        DEPTH EQUAL TO [GUTTER-HIKE + PAVEMENT LIP]

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.62   FLOOD WIDTH(FEET) =    3.00
 FLOW VELOCITY(FEET/SEC.) =   4.58   DEPTH*VELOCITY(FT*FT/SEC) =   2.86
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =   430.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
```



```
============================================================================
 UPSTREAM ELEVATION(FEET) =   67.75  DOWNSTREAM ELEVATION(FEET) =   67.44
 STREET LENGTH(FEET) =   195.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.10
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.54
  HALFSTREET FLOOD WIDTH(FEET) =   19.12
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.33
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.72
 STREET FLOW TRAVEL TIME(MIN.) =   2.45   Tc(MIN.) =  11.25
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.565
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.01      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.01     SUBAREA RUNOFF(CFS) =     0.02
 EFFECTIVE AREA(ACRES) =     1.93   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     1.93       PEAK FLOW RATE(CFS) =       5.09
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.54   HALFSTREET FLOOD WIDTH(FEET) =  19.12
 FLOW VELOCITY(FEET/SEC.) =  1.32   DEPTH*VELOCITY(FT*FT/SEC.) =   0.72
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =   625.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =  11.25
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.565
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.74      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.74     SUBAREA RUNOFF(CFS) =     1.70
 EFFECTIVE AREA(ACRES) =     2.67   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     2.67       PEAK FLOW RATE(CFS) =       6.12
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =      2.67  TC(MIN.) =     11.25
 EFFECTIVE AREA(ACRES) =      2.67  AREA-AVERAGED Fm(INCH/HR)=  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 PEAK FLOW RATE(CFS)    =      6.12
============================================================================
============================================================================
```

END OF RATIONAL METHOD ANALYSIS

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
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               Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                           Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


--------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\EX-B-10.DAT
  TIME/DATE OF STUDY: 08:57 06/07/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE     21.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   225.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.20  DOWNSTREAM(FEET) =     68.41

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.216
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.054
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                  D        0.59      0.20       0.10    75    8.22
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      1.61
  TOTAL AREA(ACRES) =      0.59   PEAK FLOW RATE(CFS) =      1.61
```



```
**************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN) =   8.22
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.080
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        0.42      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.42     SUBAREA RUNOFF(CFS) =     1.16
  EFFECTIVE AREA(ACRES) =     1.01   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     1.01       PEAK FLOW RATE(CFS) =      2.78
==========================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      1.01  TC(MIN.) =      8.22
  EFFECTIVE AREA(ACRES) =       1.01  AREA-AVERAGED Fm(INCH/HR)=  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  PEAK FLOW RATE(CFS)    =      2.78
==========================================================================
==========================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
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              Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


--------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\EX-A-25.DAT
  TIME/DATE OF STUDY: 15:40 06/09/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     10.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.70  DOWNSTREAM(FEET) =     69.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.484
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.839
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.36      0.20       0.10    75    7.48
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =       1.24
  TOTAL AREA(ACRES) =       0.36   PEAK FLOW RATE(CFS) =       1.24
```



```
**************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       2.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN) =   7.48
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.836
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.25      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.25      SUBAREA RUNOFF(CFS) =     0.86
  EFFECTIVE AREA(ACRES) =     0.61    AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     0.61      PEAK FLOW RATE(CFS) =       2.10

**************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       3.00 IS CODE =  91
--------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
==========================================================================
  UPSTREAM NODE ELEVATION(FEET) =     69.00
  DOWNSTREAM NODE ELEVATION(FEET) =     68.84
  CHANNEL LENGTH THRU SUBAREA(FEET) =    65.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.375   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =   0.70
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.740
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.44      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      2.83
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.65
  AVERAGE FLOW DEPTH(FEET) =   0.62   FLOOD WIDTH(FEET) =    3.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.41   Tc(MIN.) =   7.89
  SUBAREA AREA(ACRES) =     0.44      SUBAREA RUNOFF(CFS) =    1.47
  EFFECTIVE AREA(ACRES) =     1.05    AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =     1.05      PEAK FLOW RATE(CFS) =       3.52

         NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL
         DEPTH EQUAL TO [GUTTER-HIKE + PAVEMENT LIP]

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.62   FLOOD WIDTH(FEET) =    3.00
  FLOW VELOCITY(FEET/SEC.) =   2.65   DEPTH*VELOCITY(FT*FT/SEC) =   1.66
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE       3.00 =   250.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE       3.00 TO NODE       4.00 IS CODE =  51
--------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     68.84  DOWNSTREAM(FEET) =     68.56
  CHANNEL LENGTH THRU SUBAREA(FEET) =    70.00   CHANNEL SLOPE =  0.0040
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   6.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
```

```
 CHANNEL FLOW THRU SUBAREA(CFS) =      3.52
 FLOW VELOCITY(FEET/SEC) =   2.43   FLOW DEPTH(FEET) =   0.49
 TRAVEL TIME(MIN.) =   0.48   Tc(MIN.) =   8.37
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =   320.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =   8.37
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.631
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.51      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.51      SUBAREA RUNOFF(CFS) =     1.66
 EFFECTIVE AREA(ACRES) =     1.56    AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     1.56        PEAK FLOW RATE(CFS) =       5.07

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     68.56
 DOWNSTREAM NODE ELEVATION(FEET) =     67.75
 CHANNEL LENGTH THRU SUBAREA(FEET) =   110.00
 "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.250
 PAVEMENT LIP(FEET) =  0.375   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
 MAXIMUM DEPTH(FEET) =   0.70
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.540
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.36      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      5.64
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.58
 AVERAGE FLOW DEPTH(FEET) =   0.62   FLOOD WIDTH(FEET) =    3.00
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.40   Tc(MIN.) =   8.77
 SUBAREA AREA(ACRES) =    0.36       SUBAREA RUNOFF(CFS) =    1.14
 EFFECTIVE AREA(ACRES) =    1.92     AREA-AVERAGED Fm(INCH/HR) =   0.02
 AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
 TOTAL AREA(ACRES) =    1.92         PEAK FLOW RATE(CFS) =       6.08

        NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL
        DEPTH EQUAL TO [GUTTER-HIKE + PAVEMENT LIP]

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.62   FLOOD WIDTH(FEET) =    3.00
 FLOW VELOCITY(FEET/SEC.) =   4.58   DEPTH*VELOCITY(FT*FT/SEC) =   2.86
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =   430.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
```



```
============================================================================
 UPSTREAM ELEVATION(FEET) =   67.75  DOWNSTREAM ELEVATION(FEET) =   67.44
 STREET LENGTH(FEET) =   195.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.10
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.57
  HALFSTREET FLOOD WIDTH(FEET) =   20.51
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.39
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.79
 STREET FLOW TRAVEL TIME(MIN.) =   2.34   Tc(MIN.) =  11.12
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.086
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.01      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.01      SUBAREA RUNOFF(CFS) =     0.03
 EFFECTIVE AREA(ACRES) =     1.93    AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     1.93        PEAK FLOW RATE(CFS) =       6.08
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.57   HALFSTREET FLOOD WIDTH(FEET) =  20.51
 FLOW VELOCITY(FEET/SEC.) =  1.38   DEPTH*VELOCITY(FT*FT/SEC.) =   0.79
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =   625.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =  11.12
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.086
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D        0.74      0.20       0.10    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.74      SUBAREA RUNOFF(CFS) =     2.04
 EFFECTIVE AREA(ACRES) =     2.67    AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     2.67        PEAK FLOW RATE(CFS) =       7.37
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =      2.67  TC(MIN.) =     11.12
 EFFECTIVE AREA(ACRES) =      2.67  AREA-AVERAGED Fm(INCH/HR)=  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 PEAK FLOW RATE(CFS)    =      7.37
============================================================================
============================================================================
```

END OF RATIONAL METHOD ANALYSIS

```
**************************************************************************
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               Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


--------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\EX-B-25.DAT
  TIME/DATE OF STUDY: 08:59 06/07/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE     21.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   225.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.70  DOWNSTREAM(FEET) =     68.41

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.448
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.850
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.59      0.20       0.10    75    7.45
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      2.03
  TOTAL AREA(ACRES) =      0.59   PEAK FLOW RATE(CFS) =      2.03
```



```
**************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN) =   7.45
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.850
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.42      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.42     SUBAREA RUNOFF(CFS) =     1.45
  EFFECTIVE AREA(ACRES) =     1.01   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     1.01       PEAK FLOW RATE(CFS) =      3.48
==========================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      1.01  TC(MIN.) =      7.45
  EFFECTIVE AREA(ACRES) =       1.01  AREA-AVERAGED Fm(INCH/HR)=  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  PEAK FLOW RATE(CFS)    =      3.48
==========================================================================
==========================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


--------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\EX-A-100.DAT
  TIME/DATE OF STUDY: 15:43 06/09/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     10.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  185.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.70  DOWNSTREAM(FEET) =     69.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.484
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.910
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.36      0.20       0.10    75    7.48
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      1.58
  TOTAL AREA(ACRES) =      0.36   PEAK FLOW RATE(CFS) =      1.58
```



```
**************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       2.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN) =   7.48
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.908
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.25      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.25   SUBAREA RUNOFF(CFS) =     1.10
  EFFECTIVE AREA(ACRES) =     0.61   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     0.61   PEAK FLOW RATE(CFS) =     2.68

**************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       3.00 IS CODE =  91
--------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
==========================================================================
  UPSTREAM NODE ELEVATION(FEET) =     69.00
  DOWNSTREAM NODE ELEVATION(FEET) =     68.84
  CHANNEL LENGTH THRU SUBAREA(FEET) =    65.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.375   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =   0.70
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.784
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.44      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     3.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.65
  AVERAGE FLOW DEPTH(FEET) =   0.62   FLOOD WIDTH(FEET) =    3.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.41   Tc(MIN.) =   7.89
  SUBAREA AREA(ACRES) =     0.44   SUBAREA RUNOFF(CFS) =     1.89
  EFFECTIVE AREA(ACRES) =     1.05   AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =     1.05   PEAK FLOW RATE(CFS) =     4.50

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.66   FLOOD WIDTH(FEET) =   10.15
  FLOW VELOCITY(FEET/SEC.) =   2.59   DEPTH*VELOCITY(FT*FT/SEC) =   1.71
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE       3.00 =   250.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE       3.00 TO NODE       4.00 IS CODE =  51
--------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     68.84  DOWNSTREAM(FEET) =     68.56
  CHANNEL LENGTH THRU SUBAREA(FEET) =    70.00   CHANNEL SLOPE =  0.0040
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   6.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50

        ===>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
```

```
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

  CHANNEL FLOW THRU SUBAREA(CFS) =      4.50
  FLOW VELOCITY(FEET/SEC) =    3.00   FLOW DEPTH(FEET) =    0.50
  TRAVEL TIME(MIN.) =    0.39   Tc(MIN.) =    8.28

  ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =   320.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN) =    8.28
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.668
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        0.51      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.51      SUBAREA RUNOFF(CFS) =     2.13
  EFFECTIVE AREA(ACRES) =     1.56    AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     1.56        PEAK FLOW RATE(CFS) =       6.53

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     68.56
  DOWNSTREAM NODE ELEVATION(FEET) =     67.75
  CHANNEL LENGTH THRU SUBAREA(FEET) =   110.00
  "V" GUTTER WIDTH(FEET) =    3.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.375   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =    0.70
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.551
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        0.36      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      7.26
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.62
  AVERAGE FLOW DEPTH(FEET) =    0.64   FLOOD WIDTH(FEET) =    6.16
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =    0.40   Tc(MIN.) =    8.68
  SUBAREA AREA(ACRES) =     0.36      SUBAREA RUNOFF(CFS) =     1.47
  EFFECTIVE AREA(ACRES) =     1.92    AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =    0.10
  TOTAL AREA(ACRES) =     1.92        PEAK FLOW RATE(CFS) =       7.83

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.66   FLOOD WIDTH(FEET) =   10.38
  FLOW VELOCITY(FEET/SEC.) =   4.48   DEPTH*VELOCITY(FT*FT/SEC) =   2.97
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =   430.00 FEET.

****************************************************************************
```



```
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =    67.75  DOWNSTREAM ELEVATION(FEET) =    67.44
  STREET LENGTH(FEET) =   195.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.85
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.61
    HALFSTREET FLOOD WIDTH(FEET) =   22.62
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.90
  STREET FLOW TRAVEL TIME(MIN.) =   2.20   Tc(MIN.) =  10.88
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.985
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        0.01      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.01      SUBAREA RUNOFF(CFS) =     0.04
  EFFECTIVE AREA(ACRES) =     1.93    AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     1.93        PEAK FLOW RATE(CFS) =       7.83
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.61   HALFSTREET FLOOD WIDTH(FEET) =  22.62
  FLOW VELOCITY(FEET/SEC.) =  1.48   DEPTH*VELOCITY(FT*FT/SEC.) =   0.90
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =   625.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN) =  10.88
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.985
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        0.74      0.20       0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.74      SUBAREA RUNOFF(CFS) =     2.64
  EFFECTIVE AREA(ACRES) =     2.67    AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     2.67        PEAK FLOW RATE(CFS) =       9.53
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      2.67  TC(MIN.) =     10.88
  EFFECTIVE AREA(ACRES) =      2.67  AREA-AVERAGED Fm(INCH/HR)=  0.02
```

AREA-AVERAGED Fp(INCH/HR) = 0.20 AREA-AVERAGED Ap = 0.10
PEAK FLOW RATE(CFS) = 9.53

==========

==========

END OF RATIONAL METHOD ANALYSIS

```
**************************************************************************
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               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
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              Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


--------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\EX-B-100.DAT
  TIME/DATE OF STUDY: 09:00 06/07/2011
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-   CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE     21.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   225.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.70  DOWNSTREAM(FEET) =     68.41

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.448
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.924
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                  D        0.59      0.20        0.10    75    7.45
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      2.60
  TOTAL AREA(ACRES) =      0.59   PEAK FLOW RATE(CFS) =      2.60
```



```
**************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN) =   7.45
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.927
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  D        0.42      0.20        0.10    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.42     SUBAREA RUNOFF(CFS) =     1.85
  EFFECTIVE AREA(ACRES) =     1.01   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     1.01       PEAK FLOW RATE(CFS) =     4.46
==========================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      1.01  TC(MIN.) =      7.45
  EFFECTIVE AREA(ACRES) =       1.01  AREA-AVERAGED Fm(INCH/HR)=  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  PEAK FLOW RATE(CFS)    =      4.46
==========================================================================
==========================================================================
  END OF RATIONAL METHOD ANALYSIS
```

APPENDIX B: PROPOSED CONDITION 10-, 25-, AND 100-YEAR ANALYSIS

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
          (c) Copyright 1983-2001 Advanced Engineering Software (aes)
               Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\PROP-10.DAT
  TIME/DATE OF STUDY: 09:17 06/06/2011
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   15.0       5.0    0.020/0.020/0.020   0.40    1.00 0.0312 0.080 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   192.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.167
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.868
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.24      0.20       0.40     75    9.17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =       0.60
  TOTAL AREA(ACRES) =       0.24   PEAK FLOW RATE(CFS) =       0.60
```



```
************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE      10.00 IS CODE =  62
------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
========================================================================
  UPSTREAM ELEVATION(FEET) =    68.50  DOWNSTREAM ELEVATION(FEET) =    67.90
  STREET LENGTH(FEET) =    164.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        0.86
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =     8.21
    AVERAGE FLOW VELOCITY(FEET/SEC.) =     1.17
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     0.30
  STREET FLOW TRAVEL TIME(MIN.) =    2.35   Tc(MIN.) =  11.51
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.530
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.23      0.20       0.40     75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =     0.23      SUBAREA RUNOFF(CFS) =     0.51
  EFFECTIVE AREA(ACRES) =     0.47    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =     0.47        PEAK FLOW RATE(CFS) =        1.04

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   8.84
  FLOW VELOCITY(FEET/SEC.) =  1.23   DEPTH*VELOCITY(FT*FT/SEC.) =    0.33
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE      10.00 =    356.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE      10.00 TO NODE      10.00 IS CODE =   1
------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  11.51
  RAINFALL INTENSITY(INCH/HR) =   2.53
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =     0.47
  TOTAL STREAM AREA(ACRES) =     0.47
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.04

************************************************************************
  FLOW PROCESS FROM NODE       5.00 TO NODE       6.00 IS CODE =  21
------------------------------------------------------------------------
```

```
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.18

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.178
*  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.891
SUBAREA Tc AND LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.39      0.20       0.40    75    9.18
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA RUNOFF(CFS) =      0.99
TOTAL AREA(ACRES) =      0.39   PEAK FLOW RATE(CFS) =      0.99

****************************************************************************
FLOW PROCESS FROM NODE      6.00 TO NODE     10.00 IS CODE =  62
----------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
UPSTREAM ELEVATION(FEET) =   68.18  DOWNSTREAM ELEVATION(FEET) =   67.90
STREET LENGTH(FEET) =   112.00   CURB HEIGHT(INCHES) =  4.8
STREET HALFWIDTH(FEET) = 15.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.020
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.20
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.30
  HALFSTREET FLOOD WIDTH(FEET) =   10.20
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.09
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.32
STREET FLOW TRAVEL TIME(MIN.) =   1.71   Tc(MIN.) =  10.88
*  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.613
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    75
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.43
EFFECTIVE AREA(ACRES) =     0.58    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =     0.58        PEAK FLOW RATE(CFS) =       1.32

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =  10.59
FLOW VELOCITY(FEET/SEC.) =  1.12   DEPTH*VELOCITY(FT*FT/SEC.) =   0.34
LONGEST FLOWPATH FROM NODE      5.00 TO NODE     10.00 =   365.00 FEET.

****************************************************************************
```



```
FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TIME OF CONCENTRATION(MIN.) =  10.88
RAINFALL INTENSITY(INCH/HR) =   2.61
AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20
AREA-AVERAGED Ap =  0.40
EFFECTIVE STREAM AREA(ACRES) =    0.58
TOTAL STREAM AREA(ACRES) =    0.58
PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.32

** CONFLUENCE DATA **
 STREAM     Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
 NUMBER   (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
    1      1.04  11.51    2.530  0.20( 0.08) 0.40     0.5        1.00
    2      1.32  10.88    2.613  0.20( 0.08) 0.40     0.6        5.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR  2 STREAMS.

** PEAK FLOW RATE TABLE **
 STREAM     Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
 NUMBER   (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
    1      2.34  10.88    2.613  0.20( 0.08) 0.40     1.0        5.00
    2      2.32  11.51    2.530  0.20( 0.08) 0.40     1.0        1.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      2.34    Tc(MIN.) =    10.88
EFFECTIVE AREA(ACRES) =     1.02   AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =      1.05
LONGEST FLOWPATH FROM NODE      5.00 TO NODE     10.00 =   365.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =    67.90  DOWNSTREAM(FEET) =    67.60
FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.013
ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   4.58
ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =      2.34
PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =  11.00
LONGEST FLOWPATH FROM NODE      5.00 TO NODE     20.00 =   397.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
TIME OF CONCENTRATION(MIN.) =  11.00
RAINFALL INTENSITY(INCH/HR) =   2.60
AREA-AVERAGED Fm(INCH/HR) =  0.08
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    1.02
  TOTAL STREAM AREA(ACRES) =    1.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.34

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.36

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.709
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.983
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =      0.57
  TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.57

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   68.36  DOWNSTREAM ELEVATION(FEET) =   67.90
  STREET LENGTH(FEET) =   126.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.80
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =    7.93
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.15
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.29
  STREET FLOW TRAVEL TIME(MIN.) =   1.82   Tc(MIN.) =  10.53
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.660
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.44
  EFFECTIVE AREA(ACRES) =     0.41    AREA-AVERAGED Fm(INCH/HR) =  0.08
```



```
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =     0.41         PEAK FLOW RATE(CFS) =       0.95

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.26   HALFSTREET FLOOD WIDTH(FEET) =   8.56
  FLOW VELOCITY(FEET/SEC.) =  1.20   DEPTH*VELOCITY(FT*FT/SEC.) =   0.31
  LONGEST FLOWPATH FROM NODE     21.00 TO NODE     20.00 =   312.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =  10.53
  RAINFALL INTENSITY(INCH/HR) =   2.66
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    0.41
  TOTAL STREAM AREA(ACRES) =    0.41
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.95

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     26.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.00  DOWNSTREAM(FEET) =     68.04

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.644
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.996
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =      0.58
  TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.58

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   68.04  DOWNSTREAM ELEVATION(FEET) =   67.90
  STREET LENGTH(FEET) =    78.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199
```

```
 **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.71
 STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
 STREET FLOW DEPTH(FEET) =  0.27
 HALFSTREET FLOOD WIDTH(FEET) =    8.77
 AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.85
 PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.23
STREET FLOW TRAVEL TIME(MIN.) =   1.53   Tc(MIN.) =  10.17
*  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.708
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D         0.11      0.20       0.40    75
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =     0.11      SUBAREA RUNOFF(CFS) =     0.26
EFFECTIVE AREA(ACRES) =     0.33    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =     0.33        PEAK FLOW RATE(CFS) =       0.78

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   9.12
FLOW VELOCITY(FEET/SEC.) =  0.87   DEPTH*VELOCITY(FT*FT/SEC.) =   0.24
LONGEST FLOWPATH FROM NODE     25.00 TO NODE     20.00 =   263.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.17
 RAINFALL INTENSITY(INCH/HR) =   2.71
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    0.33
 TOTAL STREAM AREA(ACRES) =    0.33
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.78

 ** CONFLUENCE DATA **
  STREAM     Q      Tc    Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER   (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)        (ACRES)    NODE
     1      2.34  11.00     2.598   0.20( 0.08) 0.40      1.0       5.00
     1      2.32  11.63     2.515   0.20( 0.08) 0.40      1.0       1.00
     2      0.95  10.53     2.660   0.20( 0.08) 0.40      0.4      21.00
     3      0.78  10.17     2.708   0.20( 0.08) 0.40      0.3      25.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  3 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM     Q      Tc    Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER   (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)        (ACRES)    NODE
     1      3.97  10.17     2.708   0.20( 0.08) 0.40      1.7      25.00
     2      4.01  10.53     2.660   0.20( 0.08) 0.40      1.7      21.00
     3      4.01  11.00     2.598   0.20( 0.08) 0.40      1.8       5.00
     4      3.94  11.63     2.515   0.20( 0.08) 0.40      1.8       1.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      4.01    Tc(MIN.) =    11.00
```



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 EFFECTIVE AREA(ACRES) =     1.76   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      1.79
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     20.00 =   397.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.90  DOWNSTREAM(FEET) =    66.80
 FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.45
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      4.01
 PIPE TRAVEL TIME(MIN.) =   0.34    Tc(MIN.) =  11.34
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     21.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.39

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.765
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.972
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D         0.22      0.20       0.40    75    8.77
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA RUNOFF(CFS) =      0.57
 TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.57

****************************************************************************
 FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.39  DOWNSTREAM ELEVATION(FEET) =   67.80
 STREET LENGTH(FEET) =   140.00   CURB HEIGHT(INCHES) =  4.8
 STREET HALFWIDTH(FEET) = 15.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
```

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  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.81
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.25
    HALFSTREET FLOOD WIDTH(FEET) =    7.79
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.22
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.30
  STREET FLOW TRAVEL TIME(MIN.) =   1.91   Tc(MIN.) =  10.68
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.641
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.21      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =    0.21      SUBAREA RUNOFF(CFS) =    0.48
  EFFECTIVE AREA(ACRES) =    0.43    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =    0.43        PEAK FLOW RATE(CFS) =       0.99

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.26   HALFSTREET FLOOD WIDTH(FEET) =   8.42
  FLOW VELOCITY(FEET/SEC.) =  1.29   DEPTH*VELOCITY(FT*FT/SEC.) =   0.33
  LONGEST FLOWPATH FROM NODE     21.00 TO NODE     32.00 =   326.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  10.68
  RAINFALL INTENSITY(INCH/HR) =   2.64
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    0.43
  TOTAL STREAM AREA(ACRES) =    0.43
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.99

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     36.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   184.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.00  DOWNSTREAM(FEET) =     68.04

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.616
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.001
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.62
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
```



```
  SUBAREA RUNOFF(CFS) =      0.58
  TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.58

****************************************************************************
  FLOW PROCESS FROM NODE     36.00 TO NODE     32.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   68.04  DOWNSTREAM ELEVATION(FEET) =   67.80
  STREET LENGTH(FEET) =    64.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.70
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    7.50
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.12
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.27
  STREET FLOW TRAVEL TIME(MIN.) =   0.95   Tc(MIN.) =   9.57
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.815
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.10      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =    0.10      SUBAREA RUNOFF(CFS) =    0.25
  EFFECTIVE AREA(ACRES) =    0.32    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =    0.32        PEAK FLOW RATE(CFS) =       0.79

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.25   HALFSTREET FLOOD WIDTH(FEET) =   7.86
  FLOW VELOCITY(FEET/SEC.) =  1.16   DEPTH*VELOCITY(FT*FT/SEC.) =   0.29
  LONGEST FLOWPATH FROM NODE     25.00 TO NODE     32.00 =   248.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   9.57
  RAINFALL INTENSITY(INCH/HR) =   2.82
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    0.32
  TOTAL STREAM AREA(ACRES) =    0.32
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.79
```

```
 ** CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       0.99  10.68     2.641  0.20( 0.08) 0.40      0.4       21.00
     2       0.79   9.57     2.815  0.20( 0.08) 0.40      0.3       25.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       1.74   9.57     2.815  0.20( 0.08) 0.40      0.7       25.00
     2       1.73  10.68     2.641  0.20( 0.08) 0.40      0.8       21.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      1.74    Tc(MIN.) =     9.57
 EFFECTIVE AREA(ACRES) =     0.71   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      0.75
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     32.00 =   326.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     30.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.80  DOWNSTREAM(FEET) =    66.80
 FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.74
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      1.74
 PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    9.58
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     30.00 =   336.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       1.74   9.58     2.812  0.20( 0.08) 0.40      0.7       25.00
     2       1.73  10.69     2.638  0.20( 0.08) 0.40      0.8       21.00
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     30.00 =   336.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       3.97  10.51     2.663  0.20( 0.08) 0.40      1.7       25.00
     2       4.01  10.87     2.616  0.20( 0.08) 0.40      1.7       21.00
     3       4.01  11.34     2.553  0.20( 0.08) 0.40      1.8        5.00
     4       3.94  11.97     2.470  0.20( 0.08) 0.40      1.8        1.00
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       5.57   9.58     2.812  0.20( 0.08) 0.40      2.2       25.00
```



```
     2       5.70  10.51     2.663  0.20( 0.08) 0.40      2.4       25.00
     3       5.72  10.69     2.638  0.20( 0.08) 0.40      2.4       21.00
     4       5.72  10.87     2.616  0.20( 0.08) 0.40      2.5       21.00
     5       5.68  11.34     2.553  0.20( 0.08) 0.40      2.5        5.00
     6       5.55  11.97     2.470  0.20( 0.08) 0.40      2.5        1.00
   TOTAL AREA(ACRES) =      2.54

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      5.72  Tc(MIN.) =   10.866
 EFFECTIVE AREA(ACRES) =    2.47  AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      2.54
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     40.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    66.80  DOWNSTREAM(FEET) =    66.60
 FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.10
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      5.72
 PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =  10.96
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     40.00 =   537.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     40.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.96
 RAINFALL INTENSITY(INCH/HR) =   2.60
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    2.47
 TOTAL STREAM AREA(ACRES) =    2.54
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.72

****************************************************************************
 FLOW PROCESS FROM NODE      1.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   192.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.53

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.237
 *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.879
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
```

```
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"        D        0.23      0.20       0.40    75    9.24
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =       0.58
  TOTAL AREA(ACRES) =       0.23   PEAK FLOW RATE(CFS) =       0.58

****************************************************************************
  FLOW PROCESS FROM NODE      41.00 TO NODE      42.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   68.53  DOWNSTREAM ELEVATION(FEET) =   68.00
  STREET LENGTH(FEET) =   115.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.80
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    7.57
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.26
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.30
  STREET FLOW TRAVEL TIME(MIN.) =   1.53   Tc(MIN.) =  10.76
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.629
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"        D        0.19      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.44
  EFFECTIVE AREA(ACRES) =     0.42    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =     0.42         PEAK FLOW RATE(CFS) =        0.96

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.26   HALFSTREET FLOOD WIDTH(FEET) =   8.21
  FLOW VELOCITY(FEET/SEC.) =  1.31   DEPTH*VELOCITY(FT*FT/SEC.) =   0.33
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE      42.00 =   307.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      42.00 TO NODE      42.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN) =  10.76
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.629
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                   D        0.07      0.20       0.20    75
```



```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.20
  SUBAREA AREA(ACRES) =     0.07      SUBAREA RUNOFF(CFS) =     0.16
  EFFECTIVE AREA(ACRES) =     0.49   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =     0.49         PEAK FLOW RATE(CFS) =        1.13

****************************************************************************
  FLOW PROCESS FROM NODE      42.00 TO NODE      40.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    68.00  DOWNSTREAM(FEET) =    66.60
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.00
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.13
  PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =  10.98
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE      40.00 =   372.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      40.00 TO NODE      40.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =  10.98
  RAINFALL INTENSITY(INCH/HR) =   2.60
  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.37
  EFFECTIVE STREAM AREA(ACRES) =    0.49
  TOTAL STREAM AREA(ACRES) =    0.49
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.13

****************************************************************************
  FLOW PROCESS FROM NODE       5.00 TO NODE      45.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
  ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.18

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.178
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.891
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"        D        0.40      0.20       0.40    75    9.18
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =       1.01
  TOTAL AREA(ACRES) =       0.40   PEAK FLOW RATE(CFS) =       1.01

****************************************************************************
  FLOW PROCESS FROM NODE      45.00 TO NODE      46.00 IS CODE =  62
----------------------------------------------------------------------------
```

```
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
UPSTREAM ELEVATION(FEET) =    68.18  DOWNSTREAM ELEVATION(FEET) =    67.50
STREET LENGTH(FEET) =     57.00   CURB HEIGHT(INCHES) =  4.8
STREET HALFWIDTH(FEET) = 15.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.020
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        1.13
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.23
  HALFSTREET FLOOD WIDTH(FEET) =     7.15
  AVERAGE FLOW VELOCITY(FEET/SEC.) =     1.98
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     0.46
STREET FLOW TRAVEL TIME(MIN.) =    0.48   Tc(MIN.) =    9.66
*  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.797
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D         0.10      0.20       0.40    75
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =     0.10      SUBAREA RUNOFF(CFS) =     0.24
EFFECTIVE AREA(ACRES) =     0.50    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =     0.50        PEAK FLOW RATE(CFS) =        1.22

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.24   HALFSTREET FLOOD WIDTH(FEET) =   7.43
FLOW VELOCITY(FEET/SEC.) =  1.99   DEPTH*VELOCITY(FT*FT/SEC.) =   0.48
LONGEST FLOWPATH FROM NODE       5.00 TO NODE      46.00 =   310.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE      46.00 TO NODE      46.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
MAINLINE Tc(MIN) =    9.66
*  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.797
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
APARTMENTS                  D         0.07      0.20       0.20    75
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.20
SUBAREA AREA(ACRES) =     0.07      SUBAREA RUNOFF(CFS) =     0.17
EFFECTIVE AREA(ACRES) =     0.57    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.38
TOTAL AREA(ACRES) =     0.57        PEAK FLOW RATE(CFS) =        1.40

****************************************************************************
FLOW PROCESS FROM NODE      46.00 TO NODE      40.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```



```
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     67.50  DOWNSTREAM(FEET) =     66.60
FLOW LENGTH(FEET) =     40.00   MANNING'S N =  0.013
ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
DEPTH OF FLOW IN  18.0 INCH PIPE IS    3.7 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =    5.41
ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =    1
PIPE-FLOW(CFS) =       1.40
PIPE TRAVEL TIME(MIN.) =    0.12    Tc(MIN.) =    9.78
LONGEST FLOWPATH FROM NODE       5.00 TO NODE      40.00 =    350.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE      40.00 TO NODE      40.00 IS CODE =    1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
TIME OF CONCENTRATION(MIN.) =    9.78
RAINFALL INTENSITY(INCH/HR) =    2.77
AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20
AREA-AVERAGED Ap =  0.38
EFFECTIVE STREAM AREA(ACRES) =     0.57
TOTAL STREAM AREA(ACRES) =     0.57
PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.40

** CONFLUENCE DATA **
 STREAM     Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
 NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1      5.57    9.68    2.792   0.20( 0.08) 0.40      2.2       25.00
    1      5.70   10.61    2.650   0.20( 0.08) 0.40      2.4       25.00
    1      5.72   10.79    2.625   0.20( 0.08) 0.40      2.4       21.00
    1      5.72   10.96    2.603   0.20( 0.08) 0.40      2.5       21.00
    1      5.68   11.44    2.540   0.20( 0.08) 0.40      2.5        5.00
    1      5.55   12.07    2.457   0.20( 0.08) 0.40      2.5        1.00
    2      1.13   10.98    2.601   0.20( 0.07) 0.37      0.5        1.00
    3      1.40    9.78    2.773   0.20( 0.08) 0.38      0.6        5.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR  3 STREAMS.

** PEAK FLOW RATE TABLE **
 STREAM     Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
 NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1      8.03    9.68    2.792   0.20( 0.08) 0.39      3.2       25.00
    2      8.05    9.78    2.773   0.20( 0.08) 0.39      3.3        5.00
    3      8.14   10.61    2.650   0.20( 0.08) 0.39      3.5       25.00
    4      8.16   10.79    2.625   0.20( 0.08) 0.39      3.5       21.00
    5      8.16   10.96    2.603   0.20( 0.08) 0.39      3.5       21.00
    6      8.15   10.98    2.601   0.20( 0.08) 0.39      3.5        1.00
    7      8.06   11.44    2.540   0.20( 0.08) 0.39      3.6        5.00
    8      7.85   12.07    2.457   0.20( 0.08) 0.39      3.6        1.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      8.16    Tc(MIN.) =    10.79
EFFECTIVE AREA(ACRES) =     3.50   AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.39
TOTAL AREA(ACRES) =      3.60
LONGEST FLOWPATH FROM NODE       5.00 TO NODE      40.00 =    537.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE      40.00 TO NODE      50.00 IS CODE =  31
```

```
--------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    66.60  DOWNSTREAM(FEET) =    65.30
  FLOW LENGTH(FEET) =   330.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.52
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      8.16
  PIPE TRAVEL TIME(MIN.) =   1.22    Tc(MIN.) =  12.01
  LONGEST FLOWPATH FROM NODE      5.00 TO NODE     50.00 =   867.00 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      3.60  TC(MIN.) =     12.01
  EFFECTIVE AREA(ACRES) =      3.50  AREA-AVERAGED Fm(INCH/HR)=  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.39
  PEAK FLOW RATE(CFS)   =      8.16

  ** PEAK FLOW RATE TABLE **
   STREAM     Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
   NUMBER   (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)         (ACRES)     NODE
      1      8.03  10.90     2.611   0.20( 0.08) 0.39      3.2       25.00
      2      8.05  11.00     2.598   0.20( 0.08) 0.39      3.3        5.00
      3      8.14  11.82     2.489   0.20( 0.08) 0.39      3.5       25.00
      4      8.16  12.01     2.465   0.20( 0.08) 0.39      3.5       21.00
      5      8.16  12.18     2.442   0.20( 0.08) 0.39      3.5       21.00
      6      8.15  12.20     2.440   0.20( 0.08) 0.39      3.5        1.00
      7      8.06  12.66     2.385   0.20( 0.08) 0.39      3.6        5.00
      8      7.85  13.29     2.324   0.20( 0.08) 0.39      3.6        1.00
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             (Reference: 1986 OCEMA HYDROLOGY CRITERION)
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           Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                        Analysis prepared by:

                            RBF Consulting
                          14725 Alton Parkway
                           Irvine, CA  92618


------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\PROP-25.DAT
  TIME/DATE OF STUDY: 09:19 06/06/2011
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   15.0       5.0    0.020/0.020/0.020   0.40    1.00 0.0312 0.080 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   192.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     9.167
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.423
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.24      0.20       0.40    75    9.17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =       0.72
  TOTAL AREA(ACRES) =       0.24   PEAK FLOW RATE(CFS) =       0.72
```



```
************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE      10.00 IS CODE =  62
------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
========================================================================
  UPSTREAM ELEVATION(FEET) =   68.50  DOWNSTREAM ELEVATION(FEET) =   67.90
  STREET LENGTH(FEET) =   164.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.03
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.27
    HALFSTREET FLOOD WIDTH(FEET) =    8.84
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.22
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.33
  STREET FLOW TRAVEL TIME(MIN.) =   2.24   Tc(MIN.) =  11.41
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.041
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.23      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.61
  EFFECTIVE AREA(ACRES) =    0.47    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =    0.47        PEAK FLOW RATE(CFS) =       1.25

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.28   HALFSTREET FLOOD WIDTH(FEET) =   9.54
  FLOW VELOCITY(FEET/SEC.) =  1.29   DEPTH*VELOCITY(FT*FT/SEC.) =   0.36
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE      10.00 =   356.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE      10.00 TO NODE      10.00 IS CODE =   1
------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  11.41
  RAINFALL INTENSITY(INCH/HR) =   3.04
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    0.47
  TOTAL STREAM AREA(ACRES) =    0.47
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.25

************************************************************************
  FLOW PROCESS FROM NODE       5.00 TO NODE       6.00 IS CODE =  21
------------------------------------------------------------------------
```

```
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
   ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.18

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.178
   *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.448
   SUBAREA Tc AND LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D        0.39      0.20       0.40    75    9.18
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA RUNOFF(CFS) =      1.18
   TOTAL AREA(ACRES) =      0.39   PEAK FLOW RATE(CFS) =      1.18

 ****************************************************************************
   FLOW PROCESS FROM NODE      6.00 TO NODE     10.00 IS CODE =  62
 ----------------------------------------------------------------------------
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ============================================================================
   UPSTREAM ELEVATION(FEET) =   68.18  DOWNSTREAM ELEVATION(FEET) =   67.90
   STREET LENGTH(FEET) =   112.00   CURB HEIGHT(INCHES) =  4.8
   STREET HALFWIDTH(FEET) = 15.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.020
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.44
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.31
     HALFSTREET FLOOD WIDTH(FEET) =   10.98
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.14
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.35
   STREET FLOW TRAVEL TIME(MIN.) =   1.64   Tc(MIN.) =  10.82
   *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.133
   SUBAREA LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    75
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA AREA(ACRES) =    0.19      SUBAREA RUNOFF(CFS) =    0.52
   EFFECTIVE AREA(ACRES) =    0.58    AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =    0.58        PEAK FLOW RATE(CFS) =       1.59

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.32   HALFSTREET FLOOD WIDTH(FEET) =  11.37
   FLOW VELOCITY(FEET/SEC.) =  1.18   DEPTH*VELOCITY(FT*FT/SEC.) =   0.38
   LONGEST FLOWPATH FROM NODE      5.00 TO NODE     10.00 =   365.00 FEET.

 ****************************************************************************
```



```
   FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
   >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  2
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
   TIME OF CONCENTRATION(MIN.) =  10.82
   RAINFALL INTENSITY(INCH/HR) =   3.13
   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20
   AREA-AVERAGED Ap =  0.40
   EFFECTIVE STREAM AREA(ACRES) =    0.58
   TOTAL STREAM AREA(ACRES) =    0.58
   PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.59

   ** CONFLUENCE DATA **
    STREAM     Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
    NUMBER   (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
       1      1.25  11.41     3.041  0.20( 0.08) 0.40     0.5        1.00
       2      1.59  10.82     3.133  0.20( 0.08) 0.40     0.6        5.00

   RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
   CONFLUENCE FORMULA USED FOR  2 STREAMS.

   ** PEAK FLOW RATE TABLE **
    STREAM     Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
    NUMBER   (CFS)  (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
       1      2.82  10.82     3.133  0.20( 0.08) 0.40     1.0        5.00
       2      2.80  11.41     3.041  0.20( 0.08) 0.40     1.0        1.00

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      2.82    Tc(MIN.) =    10.82
   EFFECTIVE AREA(ACRES) =     1.03   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =      1.05
   LONGEST FLOWPATH FROM NODE      5.00 TO NODE     10.00 =   365.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  31
 ----------------------------------------------------------------------------
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =    67.90  DOWNSTREAM(FEET) =    67.60
   FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.6 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   4.83
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      2.82
   PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =  10.93
   LONGEST FLOWPATH FROM NODE      5.00 TO NODE     20.00 =   397.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  3
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
   TIME OF CONCENTRATION(MIN.) =  10.93
   RAINFALL INTENSITY(INCH/HR) =   3.12
   AREA-AVERAGED Fm(INCH/HR) =  0.08
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  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    1.03
  TOTAL STREAM AREA(ACRES) =    1.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.82

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.36

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.709
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.554
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =      0.69
  TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.69

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   68.36  DOWNSTREAM ELEVATION(FEET) =   67.90
  STREET LENGTH(FEET) =   126.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      0.95
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    8.56
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.20
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.32
  STREET FLOW TRAVEL TIME(MIN.) =   1.75   Tc(MIN.) =  10.46
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.189
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.53
  EFFECTIVE AREA(ACRES) =     0.41    AREA-AVERAGED Fm(INCH/HR) =  0.08
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  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =     0.41         PEAK FLOW RATE(CFS) =       1.15

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.28   HALFSTREET FLOOD WIDTH(FEET) =   9.26
  FLOW VELOCITY(FEET/SEC.) =  1.25   DEPTH*VELOCITY(FT*FT/SEC.) =   0.35
  LONGEST FLOWPATH FROM NODE     21.00 TO NODE     20.00 =   312.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =  10.46
  RAINFALL INTENSITY(INCH/HR) =   3.19
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    0.41
  TOTAL STREAM AREA(ACRES) =    0.41
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.15

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     26.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.00  DOWNSTREAM(FEET) =     68.04

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.644
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.569
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =      0.69
  TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.69

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   68.04  DOWNSTREAM ELEVATION(FEET) =   67.90
  STREET LENGTH(FEET) =    78.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199
```

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 **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      0.85
 STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
 STREET FLOW DEPTH(FEET) =  0.28
 HALFSTREET FLOOD WIDTH(FEET) =    9.47
 AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.88
 PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.25
STREET FLOW TRAVEL TIME(MIN.) =   1.47   Tc(MIN.) =  10.11
*  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.242
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.11      0.20       0.40    75
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =     0.11      SUBAREA RUNOFF(CFS) =     0.31
EFFECTIVE AREA(ACRES) =     0.33    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =     0.33        PEAK FLOW RATE(CFS) =       0.94

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =   9.82
FLOW VELOCITY(FEET/SEC.) =  0.91   DEPTH*VELOCITY(FT*FT/SEC.) =   0.26
LONGEST FLOWPATH FROM NODE     25.00 TO NODE     20.00 =   263.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.11
 RAINFALL INTENSITY(INCH/HR) =   3.24
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    0.33
 TOTAL STREAM AREA(ACRES) =    0.33
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.94

 ** CONFLUENCE DATA **
  STREAM     Q     Tc    Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)       (ACRES)    NODE
     1      2.82  10.93    3.116  0.20( 0.08) 0.40     1.0       5.00
     1      2.80  11.52    3.023  0.20( 0.08) 0.40     1.0       1.00
     2      1.15  10.46    3.189  0.20( 0.08) 0.40     0.4      21.00
     3      0.94  10.11    3.242  0.20( 0.08) 0.40     0.3      25.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  3 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM     Q     Tc    Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)       (ACRES)    NODE
     1      4.79  10.11    3.242  0.20( 0.08) 0.40     1.7      25.00
     2      4.83  10.46    3.189  0.20( 0.08) 0.40     1.7      21.00
     3      4.84  10.93    3.116  0.20( 0.08) 0.40     1.8       5.00
     4      4.76  11.52    3.023  0.20( 0.08) 0.40     1.8       1.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      4.84    Tc(MIN.) =    10.93
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 EFFECTIVE AREA(ACRES) =     1.77   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      1.79
 LONGEST FLOWPATH FROM NODE       5.00 TO NODE     20.00 =   397.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.90  DOWNSTREAM(FEET) =    66.80
 FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.71
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      4.84
 PIPE TRAVEL TIME(MIN.) =   0.32    Tc(MIN.) =  11.25
 LONGEST FLOWPATH FROM NODE       5.00 TO NODE     30.00 =   507.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     21.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.39

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.765
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.541
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.77
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA RUNOFF(CFS) =      0.69
 TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.69

****************************************************************************
 FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.39  DOWNSTREAM ELEVATION(FEET) =   67.80
 STREET LENGTH(FEET) =   140.00   CURB HEIGHT(INCHES) =  4.8
 STREET HALFWIDTH(FEET) = 15.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
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 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.98
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.26
   HALFSTREET FLOOD WIDTH(FEET) =    8.42
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.27
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.33
 STREET FLOW TRAVEL TIME(MIN.) =   1.84   Tc(MIN.) =  10.60
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.166
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.21      0.20       0.40    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA AREA(ACRES) =     0.21      SUBAREA RUNOFF(CFS) =     0.58
 EFFECTIVE AREA(ACRES) =     0.43    AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =     0.43        PEAK FLOW RATE(CFS) =       1.19

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   9.12
 FLOW VELOCITY(FEET/SEC.) =  1.34   DEPTH*VELOCITY(FT*FT/SEC.) =   0.37
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     32.00 =   326.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.60
 RAINFALL INTENSITY(INCH/HR) =   3.17
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    0.43
 TOTAL STREAM AREA(ACRES) =    0.43
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.19

****************************************************************************
 FLOW PROCESS FROM NODE     25.00 TO NODE     36.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   184.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.00  DOWNSTREAM(FEET) =     68.04

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.616
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.576
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.62
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
```



```
 SUBAREA RUNOFF(CFS) =      0.69
 TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.69

****************************************************************************
 FLOW PROCESS FROM NODE     36.00 TO NODE     32.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.04  DOWNSTREAM ELEVATION(FEET) =   67.80
 STREET LENGTH(FEET) =    64.00   CURB HEIGHT(INCHES) =  4.8
 STREET HALFWIDTH(FEET) = 15.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.84
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.25
   HALFSTREET FLOOD WIDTH(FEET) =    8.07
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.18
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.30
 STREET FLOW TRAVEL TIME(MIN.) =   0.90   Tc(MIN.) =   9.52
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.369
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.10      0.20       0.40    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA AREA(ACRES) =     0.10      SUBAREA RUNOFF(CFS) =     0.30
 EFFECTIVE AREA(ACRES) =     0.32    AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =     0.32        PEAK FLOW RATE(CFS) =       0.95

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.26   HALFSTREET FLOOD WIDTH(FEET) =   8.49
 FLOW VELOCITY(FEET/SEC.) =  1.21   DEPTH*VELOCITY(FT*FT/SEC.) =   0.32
 LONGEST FLOWPATH FROM NODE     25.00 TO NODE     32.00 =   248.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.52
 RAINFALL INTENSITY(INCH/HR) =   3.37
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    0.32
 TOTAL STREAM AREA(ACRES) =    0.32
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.95
```

```
 ** CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)     Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       1.19  10.60     3.166  0.20( 0.08) 0.40      0.4       21.00
     2       0.95   9.52     3.369  0.20( 0.08) 0.40      0.3       25.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)     Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       2.09   9.52     3.369  0.20( 0.08) 0.40      0.7       25.00
     2       2.08  10.60     3.166  0.20( 0.08) 0.40      0.8       21.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      2.09    Tc(MIN.) =     9.52
 EFFECTIVE AREA(ACRES) =     0.71   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      0.75
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     32.00 =   326.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     30.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.80  DOWNSTREAM(FEET) =    66.80
 FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  10.30
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      2.09
 PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   9.54
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     30.00 =   336.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)     Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       2.09   9.54     3.366  0.20( 0.08) 0.40      0.7       25.00
     2       2.08  10.62     3.163  0.20( 0.08) 0.40      0.8       21.00
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     30.00 =   336.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)     Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       4.79  10.44     3.192  0.20( 0.08) 0.40      1.7       25.00
     2       4.83  10.78     3.139  0.20( 0.08) 0.40      1.7       21.00
     3       4.84  11.25     3.065  0.20( 0.08) 0.40      1.8        5.00
     4       4.76  11.84     2.973  0.20( 0.08) 0.40      1.8        1.00
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)     Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       6.71   9.54     3.366  0.20( 0.08) 0.40      2.2       25.00
```



```
     2       6.87  10.44     3.192  0.20( 0.08) 0.40      2.4       25.00
     3       6.89  10.62     3.163  0.20( 0.08) 0.40      2.5       21.00
     4       6.90  10.78     3.139  0.20( 0.08) 0.40      2.5       21.00
     5       6.86  11.25     3.065  0.20( 0.08) 0.40      2.5        5.00
     6       6.71  11.84     2.973  0.20( 0.08) 0.40      2.5        1.00
   TOTAL AREA(ACRES) =      2.54

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      6.90  Tc(MIN.) =   10.778
 EFFECTIVE AREA(ACRES) =    2.47  AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      2.54
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     40.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    66.80  DOWNSTREAM(FEET) =    66.60
 FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.28
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      6.90
 PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =  10.87
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     40.00 =   537.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     40.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.87
 RAINFALL INTENSITY(INCH/HR) =   3.12
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    2.47
 TOTAL STREAM AREA(ACRES) =    2.54
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.90

****************************************************************************
 FLOW PROCESS FROM NODE      1.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   192.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.53

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.237
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.434
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
```

```
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.23      0.20       0.40    75    9.24
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =       0.69
  TOTAL AREA(ACRES) =       0.23   PEAK FLOW RATE(CFS) =       0.69

****************************************************************************
  FLOW PROCESS FROM NODE      41.00 TO NODE      42.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =    68.53  DOWNSTREAM ELEVATION(FEET) =    68.00
  STREET LENGTH(FEET) =    115.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.96
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    8.21
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.30
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.33
  STREET FLOW TRAVEL TIME(MIN.) =   1.47   Tc(MIN.) =  10.71
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.149
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.52
  EFFECTIVE AREA(ACRES) =     0.42    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =     0.42         PEAK FLOW RATE(CFS) =       1.16

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   8.84
  FLOW VELOCITY(FEET/SEC.) =  1.38   DEPTH*VELOCITY(FT*FT/SEC.) =   0.37
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE      42.00 =   307.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      42.00 TO NODE      42.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN) =  10.71
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.149
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                  D        0.07      0.20       0.20    75
```



```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.20
  SUBAREA AREA(ACRES) =     0.07      SUBAREA RUNOFF(CFS) =     0.20
  EFFECTIVE AREA(ACRES) =     0.49   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =     0.49         PEAK FLOW RATE(CFS) =       1.36

****************************************************************************
  FLOW PROCESS FROM NODE      42.00 TO NODE      40.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    68.00  DOWNSTREAM(FEET) =    66.60
  FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.27
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.36
  PIPE TRAVEL TIME(MIN.) =   0.21    Tc(MIN.) =  10.92
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE      40.00 =   372.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      40.00 TO NODE      40.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =  10.92
  RAINFALL INTENSITY(INCH/HR) =   3.12
  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.37
  EFFECTIVE STREAM AREA(ACRES) =    0.49
  TOTAL STREAM AREA(ACRES) =    0.49
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.36

****************************************************************************
  FLOW PROCESS FROM NODE       5.00 TO NODE      45.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
  ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.18

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.178
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.448
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.40      0.20       0.40    75    9.18
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =       1.21
  TOTAL AREA(ACRES) =       0.40   PEAK FLOW RATE(CFS) =       1.21

****************************************************************************
  FLOW PROCESS FROM NODE      45.00 TO NODE      46.00 IS CODE =  62
----------------------------------------------------------------------------
```

```
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
UPSTREAM ELEVATION(FEET) =    68.18  DOWNSTREAM ELEVATION(FEET) =    67.50
STREET LENGTH(FEET) =     57.00   CURB HEIGHT(INCHES) =  4.8
STREET HALFWIDTH(FEET) = 15.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.020
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        1.36
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.25
  HALFSTREET FLOOD WIDTH(FEET) =     7.79
  AVERAGE FLOW VELOCITY(FEET/SEC.) =     2.04
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     0.50
STREET FLOW TRAVEL TIME(MIN.) =    0.47   Tc(MIN.) =    9.64
*  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.341
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.10      0.20       0.40     75
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =     0.10      SUBAREA RUNOFF(CFS) =     0.29
EFFECTIVE AREA(ACRES) =     0.50    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =     0.50        PEAK FLOW RATE(CFS) =        1.47

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.25   HALFSTREET FLOOD WIDTH(FEET) =    8.00
FLOW VELOCITY(FEET/SEC.) =  2.09   DEPTH*VELOCITY(FT*FT/SEC.) =    0.53
LONGEST FLOWPATH FROM NODE       5.00 TO NODE      46.00 =   310.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      46.00 TO NODE      46.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =    9.64
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.341
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 APARTMENTS                  D        0.07      0.20       0.20     75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.20
 SUBAREA AREA(ACRES) =     0.07      SUBAREA RUNOFF(CFS) =     0.21
 EFFECTIVE AREA(ACRES) =     0.57    AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.38
 TOTAL AREA(ACRES) =     0.57        PEAK FLOW RATE(CFS) =        1.68

****************************************************************************
 FLOW PROCESS FROM NODE      46.00 TO NODE      40.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```



```
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.50  DOWNSTREAM(FEET) =    66.60
 FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.70
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      1.68
 PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   9.76
 LONGEST FLOWPATH FROM NODE       5.00 TO NODE      40.00 =   350.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      40.00 TO NODE      40.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.76
 RAINFALL INTENSITY(INCH/HR) =   3.31
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.38
 EFFECTIVE STREAM AREA(ACRES) =    0.57
 TOTAL STREAM AREA(ACRES) =    0.57
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.68

 ** CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1       6.71   9.63    3.344  0.20( 0.08) 0.40      2.2       25.00
     1       6.87  10.53    3.177  0.20( 0.08) 0.40      2.4       25.00
     1       6.89  10.71    3.149  0.20( 0.08) 0.40      2.5       21.00
     1       6.90  10.87    3.124  0.20( 0.08) 0.40      2.5       21.00
     1       6.86  11.34    3.051  0.20( 0.08) 0.40      2.5        5.00
     1       6.71  11.93    2.958  0.20( 0.08) 0.40      2.5        1.00
     2       1.36  10.92    3.117  0.20( 0.07) 0.37      0.5        1.00
     3       1.68   9.76    3.314  0.20( 0.08) 0.38      0.6        5.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  3 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1       9.66   9.63    3.344  0.20( 0.08) 0.39      3.2       25.00
     2       9.70   9.76    3.314  0.20( 0.08) 0.39      3.3        5.00
     3       9.81  10.53    3.177  0.20( 0.08) 0.39      3.5       25.00
     4       9.83  10.71    3.149  0.20( 0.08) 0.39      3.5       21.00
     5       9.83  10.87    3.124  0.20( 0.08) 0.39      3.5       21.00
     6       9.82  10.92    3.117  0.20( 0.08) 0.39      3.5        1.00
     7       9.72  11.34    3.051  0.20( 0.08) 0.39      3.6        5.00
     8       9.49  11.93    2.958  0.20( 0.08) 0.39      3.6        1.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      9.83    Tc(MIN.) =    10.87
 EFFECTIVE AREA(ACRES) =     3.53   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.39
 TOTAL AREA(ACRES) =      3.60
 LONGEST FLOWPATH FROM NODE       5.00 TO NODE      40.00 =   537.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      40.00 TO NODE      50.00 IS CODE =  31
```

```
--------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    66.60  DOWNSTREAM(FEET) =    65.30
  FLOW LENGTH(FEET) =   330.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  14.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.78
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      9.83
  PIPE TRAVEL TIME(MIN.) =   1.15    Tc(MIN.) =  12.02
  LONGEST FLOWPATH FROM NODE       5.00 TO NODE     50.00 =   867.00 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      3.60  TC(MIN.) =     12.02
  EFFECTIVE AREA(ACRES) =      3.53  AREA-AVERAGED Fm(INCH/HR)=  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.39
  PEAK FLOW RATE(CFS)   =      9.83

  ** PEAK FLOW RATE TABLE **
   STREAM     Q     Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
   NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)     NODE
      1      9.66  10.83    3.131  0.20( 0.08) 0.39     3.2       25.00
      2      9.70  10.91    3.117  0.20( 0.08) 0.39     3.3        5.00
      3      9.81  11.68    2.998  0.20( 0.08) 0.39     3.5       25.00
      4      9.83  11.87    2.969  0.20( 0.08) 0.39     3.5       21.00
      5      9.83  12.02    2.944  0.20( 0.08) 0.39     3.5       21.00
      6      9.82  12.07    2.938  0.20( 0.08) 0.39     3.5        1.00
      7      9.72  12.49    2.871  0.20( 0.08) 0.39     3.6        5.00
      8      9.49  13.13    2.799  0.20( 0.08) 0.39     3.6        1.00
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
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               Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\PRP-100.DAT
  TIME/DATE OF STUDY: 09:20 06/06/2011
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.    (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   15.0      5.0    0.020/0.020/0.020   0.40    1.00 0.0312 0.080 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   192.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.167
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.372
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      D        0.24      0.20       0.40    75    9.17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =      0.93
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.93
```



```
************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE     10.00 IS CODE =  62
------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
========================================================================
  UPSTREAM ELEVATION(FEET) =    68.50  DOWNSTREAM ELEVATION(FEET) =    67.90
  STREET LENGTH(FEET) =    164.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        1.32
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.29
    HALFSTREET FLOOD WIDTH(FEET) =     9.75
    AVERAGE FLOW VELOCITY(FEET/SEC.) =     1.31
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     0.37
  STREET FLOW TRAVEL TIME(MIN.) =    2.09   Tc(MIN.) =  11.26
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.908
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      D        0.23      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =     0.23      SUBAREA RUNOFF(CFS) =     0.79
  EFFECTIVE AREA(ACRES) =     0.47    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =     0.47       PEAK FLOW RATE(CFS) =        1.62

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =  10.59
  FLOW VELOCITY(FEET/SEC.) =  1.37   DEPTH*VELOCITY(FT*FT/SEC.) =    0.42
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE      10.00 =    356.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  11.26
  RAINFALL INTENSITY(INCH/HR) =    3.91
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =     0.47
  TOTAL STREAM AREA(ACRES) =     0.47
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.62

************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  21
------------------------------------------------------------------------
```

```
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
   ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.18

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.178
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.403
   SUBAREA Tc AND LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D         0.39      0.20       0.40    75    9.18
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA RUNOFF(CFS) =      1.52
   TOTAL AREA(ACRES) =      0.39   PEAK FLOW RATE(CFS) =      1.52

 ****************************************************************************
   FLOW PROCESS FROM NODE      6.00 TO NODE     10.00 IS CODE =  62
 ----------------------------------------------------------------------------
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ============================================================================
   UPSTREAM ELEVATION(FEET) =   68.18  DOWNSTREAM ELEVATION(FEET) =   67.90
   STREET LENGTH(FEET) =   112.00   CURB HEIGHT(INCHES) =  4.8
   STREET HALFWIDTH(FEET) = 15.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.020
   OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.85
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.33
     HALFSTREET FLOOD WIDTH(FEET) =   12.07
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.22
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.41
   STREET FLOW TRAVEL TIME(MIN.) =   1.53   Tc(MIN.) =  10.71
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.019
   SUBAREA LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D         0.19      0.20       0.40    75
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.67
   EFFECTIVE AREA(ACRES) =     0.58    AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =     0.58         PEAK FLOW RATE(CFS) =       2.06

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.34   HALFSTREET FLOOD WIDTH(FEET) =  12.62
   FLOW VELOCITY(FEET/SEC.) =  1.24   DEPTH*VELOCITY(FT*FT/SEC.) =   0.43
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      10.00 =   365.00 FEET.

 ****************************************************************************
```



```
   FLOW PROCESS FROM NODE      10.00 TO NODE      10.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
   >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  2
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
   TIME OF CONCENTRATION(MIN.) =  10.71
   RAINFALL INTENSITY(INCH/HR) =   4.02
   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20
   AREA-AVERAGED Ap =  0.40
   EFFECTIVE STREAM AREA(ACRES) =     0.58
   TOTAL STREAM AREA(ACRES) =     0.58
   PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.06

   ** CONFLUENCE DATA **
    STREAM      Q      Tc    Intensity   Fp(Fm)      Ap   Ae      HEADWATER
    NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
       1       1.62  11.26     3.908   0.20( 0.08) 0.40      0.5         1.00
       2       2.06  10.71     4.019   0.20( 0.08) 0.40      0.6         5.00

   RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
   CONFLUENCE FORMULA USED FOR  2 STREAMS.

   ** PEAK FLOW RATE TABLE **
    STREAM      Q      Tc    Intensity   Fp(Fm)      Ap   Ae      HEADWATER
    NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
       1       3.64  10.71     4.019   0.20( 0.08) 0.40      1.0         5.00
       2       3.62  11.26     3.908   0.20( 0.08) 0.40      1.0         1.00

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =       3.64    Tc(MIN.) =    10.71
   EFFECTIVE AREA(ACRES) =      1.03   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =      1.05
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      10.00 =   365.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      10.00 TO NODE      20.00 IS CODE =  31
 ----------------------------------------------------------------------------
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     67.90  DOWNSTREAM(FEET) =     67.60
   FLOW LENGTH(FEET) =     32.00   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.5 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   5.18
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      3.64
   PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =  10.81
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      20.00 =   397.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      20.00 TO NODE      20.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  3
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
   TIME OF CONCENTRATION(MIN.) =  10.81
   RAINFALL INTENSITY(INCH/HR) =   4.00
   AREA-AVERAGED Fm(INCH/HR) =  0.08
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    1.03
  TOTAL STREAM AREA(ACRES) =    1.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.64

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.36

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.709
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.542
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =      0.88
  TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.88

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =    68.36  DOWNSTREAM ELEVATION(FEET) =    67.90
  STREET LENGTH(FEET) =    126.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.23
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.28
    HALFSTREET FLOOD WIDTH(FEET) =    9.47
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.28
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.36
  STREET FLOW TRAVEL TIME(MIN.) =   1.64   Tc(MIN.) =  10.35
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.090
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.69
  EFFECTIVE AREA(ACRES) =     0.41    AREA-AVERAGED Fm(INCH/HR) =  0.08
```



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  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =     0.41         PEAK FLOW RATE(CFS) =       1.48

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =  10.27
  FLOW VELOCITY(FEET/SEC.) =  1.33   DEPTH*VELOCITY(FT*FT/SEC.) =   0.39
  LONGEST FLOWPATH FROM NODE     21.00 TO NODE     20.00 =   312.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =  10.35
  RAINFALL INTENSITY(INCH/HR) =   4.09
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    0.41
  TOTAL STREAM AREA(ACRES) =    0.41
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.48

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     26.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.00  DOWNSTREAM(FEET) =     68.04

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.644
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.561
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =      0.89
  TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.89

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =    68.04  DOWNSTREAM ELEVATION(FEET) =    67.90
  STREET LENGTH(FEET) =     78.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199
```

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 **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.09
 STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
 STREET FLOW DEPTH(FEET) =  0.30
 HALFSTREET FLOOD WIDTH(FEET) =   10.43
 AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.95
 PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.28
STREET FLOW TRAVEL TIME(MIN.) =   1.37   Tc(MIN.) =  10.02
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.157
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.11      0.20       0.40    75
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =     0.11     SUBAREA RUNOFF(CFS) =     0.40
EFFECTIVE AREA(ACRES) =     0.33    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =     0.33        PEAK FLOW RATE(CFS) =       1.21

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.31   HALFSTREET FLOOD WIDTH(FEET) =  10.90
FLOW VELOCITY(FEET/SEC.) =  0.97   DEPTH*VELOCITY(FT*FT/SEC.) =   0.30
LONGEST FLOWPATH FROM NODE     25.00 TO NODE     20.00 =   263.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.02
 RAINFALL INTENSITY(INCH/HR) =   4.16
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    0.33
 TOTAL STREAM AREA(ACRES) =    0.33
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.21

 ** CONFLUENCE DATA **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
     1      3.64  10.81    3.998  0.20( 0.08) 0.40     1.0       5.00
     1      3.62  11.36    3.887  0.20( 0.08) 0.40     1.0       1.00
     2      1.48  10.35    4.090  0.20( 0.08) 0.40     0.4      21.00
     3      1.21  10.02    4.157  0.20( 0.08) 0.40     0.3      25.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  3 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
     1      6.18  10.02    4.157  0.20( 0.08) 0.40     1.7      25.00
     2      6.24  10.35    4.090  0.20( 0.08) 0.40     1.7      21.00
     3      6.25  10.81    3.998  0.20( 0.08) 0.40     1.8       5.00
     4      6.15  11.36    3.887  0.20( 0.08) 0.40     1.8       1.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      6.25    Tc(MIN.) =    10.81
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 EFFECTIVE AREA(ACRES) =     1.77   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      1.79
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     20.00 =   397.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.90  DOWNSTREAM(FEET) =    66.80
 FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.08
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      6.25
 PIPE TRAVEL TIME(MIN.) =   0.30    Tc(MIN.) =  11.11
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     21.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.39

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.765
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.525
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.77
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA RUNOFF(CFS) =      0.88
 TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.88

****************************************************************************
 FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.39  DOWNSTREAM ELEVATION(FEET) =   67.80
 STREET LENGTH(FEET) =   140.00   CURB HEIGHT(INCHES) =  4.8
 STREET HALFWIDTH(FEET) = 15.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
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   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.26
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.28
     HALFSTREET FLOOD WIDTH(FEET) =    9.33
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.35
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.37
   STREET FLOW TRAVEL TIME(MIN.) =   1.73   Tc(MIN.) =  10.50
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.061
   SUBAREA LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D        0.21      0.20       0.40    75
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA AREA(ACRES) =    0.21      SUBAREA RUNOFF(CFS) =    0.75
   EFFECTIVE AREA(ACRES) =    0.43    AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =    0.43       PEAK FLOW RATE(CFS) =       1.54

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =  10.12
   FLOW VELOCITY(FEET/SEC.) =  1.42   DEPTH*VELOCITY(FT*FT/SEC.) =   0.42
   LONGEST FLOWPATH FROM NODE     21.00 TO NODE     32.00 =   326.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  2
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
   TIME OF CONCENTRATION(MIN.) =  10.50
   RAINFALL INTENSITY(INCH/HR) =   4.06
   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20
   AREA-AVERAGED Ap =  0.40
   EFFECTIVE STREAM AREA(ACRES) =    0.43
   TOTAL STREAM AREA(ACRES) =    0.43
   PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.54

 ****************************************************************************
   FLOW PROCESS FROM NODE     25.00 TO NODE     36.00 IS CODE =  21
 ----------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   184.00
   ELEVATION DATA: UPSTREAM(FEET) =     69.00  DOWNSTREAM(FEET) =     68.04

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.616
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.570
   SUBAREA Tc AND LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    75    8.62
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
```



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   SUBAREA RUNOFF(CFS) =      0.89
   TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.89

 ****************************************************************************
   FLOW PROCESS FROM NODE     36.00 TO NODE     32.00 IS CODE =  62
 ----------------------------------------------------------------------------
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ============================================================================
   UPSTREAM ELEVATION(FEET) =   68.04  DOWNSTREAM ELEVATION(FEET) =   67.80
   STREET LENGTH(FEET) =    64.00   CURB HEIGHT(INCHES) =  4.8
   STREET HALFWIDTH(FEET) = 15.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.020
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.08
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.27
     HALFSTREET FLOOD WIDTH(FEET) =    8.98
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.24
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.34
   STREET FLOW TRAVEL TIME(MIN.) =   0.86   Tc(MIN.) =   9.47
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.316
   SUBAREA LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D        0.10      0.20       0.40    75
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA AREA(ACRES) =    0.10      SUBAREA RUNOFF(CFS) =    0.38
   EFFECTIVE AREA(ACRES) =    0.32    AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =    0.32       PEAK FLOW RATE(CFS) =       1.22

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.28   HALFSTREET FLOOD WIDTH(FEET) =   9.40
   FLOW VELOCITY(FEET/SEC.) =  1.29   DEPTH*VELOCITY(FT*FT/SEC.) =   0.36
   LONGEST FLOWPATH FROM NODE     25.00 TO NODE     32.00 =   248.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
   >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  2
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
   TIME OF CONCENTRATION(MIN.) =   9.47
   RAINFALL INTENSITY(INCH/HR) =   4.32
   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20
   AREA-AVERAGED Ap =  0.40
   EFFECTIVE STREAM AREA(ACRES) =    0.32
   TOTAL STREAM AREA(ACRES) =    0.32
   PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.22
```

```
 ** CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       1.54  10.50     4.061  0.20( 0.08) 0.40      0.4       21.00
     2       1.22   9.47     4.316  0.20( 0.08) 0.40      0.3       25.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       2.70   9.47     4.316  0.20( 0.08) 0.40      0.7       25.00
     2       2.69  10.50     4.061  0.20( 0.08) 0.40      0.8       21.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      2.70    Tc(MIN.) =     9.47
 EFFECTIVE AREA(ACRES) =     0.71   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      0.75
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     32.00 =   326.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     30.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.80  DOWNSTREAM(FEET) =    66.80
 FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  11.10
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      2.70
 PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   9.49
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     30.00 =   336.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       2.70   9.49     4.311  0.20( 0.08) 0.40      0.7       25.00
     2       2.69  10.51     4.058  0.20( 0.08) 0.40      0.8       21.00
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     30.00 =   336.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       6.18  10.32     4.096  0.20( 0.08) 0.40      1.7       25.00
     2       6.24  10.65     4.030  0.20( 0.08) 0.40      1.7       21.00
     3       6.25  11.11     3.938  0.20( 0.08) 0.40      1.8        5.00
     4       6.15  11.66     3.827  0.20( 0.08) 0.40      1.8        1.00
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1       8.68   9.49     4.311  0.20( 0.08) 0.40      2.3       25.00
```



```
     2       8.87  10.32     4.096  0.20( 0.08) 0.40      2.4       25.00
     3       8.90  10.51     4.058  0.20( 0.08) 0.40      2.5       21.00
     4       8.91  10.65     4.030  0.20( 0.08) 0.40      2.5       21.00
     5       8.86  11.11     3.938  0.20( 0.08) 0.40      2.5        5.00
     6       8.68  11.66     3.827  0.20( 0.08) 0.40      2.5        1.00
   TOTAL AREA(ACRES) =      2.54

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      8.91  Tc(MIN.) =   10.652
 EFFECTIVE AREA(ACRES) =    2.47  AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      2.54
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     40.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    66.80  DOWNSTREAM(FEET) =    66.60
 FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.68
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      8.91
 PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =  10.74
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     40.00 =   537.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     40.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.74
 RAINFALL INTENSITY(INCH/HR) =   4.01
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    2.47
 TOTAL STREAM AREA(ACRES) =    2.54
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      8.91

****************************************************************************
 FLOW PROCESS FROM NODE      1.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   192.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.53

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.237
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.386
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
```

```
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D        0.23      0.20       0.40    75    9.24
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA RUNOFF(CFS) =       0.89
   TOTAL AREA(ACRES) =      0.23   PEAK FLOW RATE(CFS) =      0.89

 ****************************************************************************
   FLOW PROCESS FROM NODE      41.00 TO NODE      42.00 IS CODE =  62
 ----------------------------------------------------------------------------
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ============================================================================
   UPSTREAM ELEVATION(FEET) =   68.53  DOWNSTREAM ELEVATION(FEET) =   68.00
   STREET LENGTH(FEET) =   115.00   CURB HEIGHT(INCHES) =  4.8
   STREET HALFWIDTH(FEET) = 15.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.020
   OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.23
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.27
     HALFSTREET FLOOD WIDTH(FEET) =    9.05
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.40
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.38
   STREET FLOW TRAVEL TIME(MIN.) =   1.37   Tc(MIN.) =  10.61
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.038
   SUBAREA LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    75
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.68
   EFFECTIVE AREA(ACRES) =     0.42    AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =     0.42         PEAK FLOW RATE(CFS) =        1.50

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =   9.82
   FLOW VELOCITY(FEET/SEC.) =  1.46   DEPTH*VELOCITY(FT*FT/SEC.) =   0.42
   LONGEST FLOWPATH FROM NODE       1.00 TO NODE      42.00 =   307.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      42.00 TO NODE      42.00 IS CODE =  81
 ----------------------------------------------------------------------------
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
 ============================================================================
   MAINLINE Tc(MIN) =  10.61
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.038
   SUBAREA LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   APARTMENTS                   D       0.07      0.20       0.20    75
```



```
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.20
   SUBAREA AREA(ACRES) =     0.07      SUBAREA RUNOFF(CFS) =     0.25
   EFFECTIVE AREA(ACRES) =     0.49    AREA-AVERAGED Fm(INCH/HR) =  0.07
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.37
   TOTAL AREA(ACRES) =     0.49         PEAK FLOW RATE(CFS) =        1.75

 ****************************************************************************
   FLOW PROCESS FROM NODE      42.00 TO NODE      40.00 IS CODE =  31
 ----------------------------------------------------------------------------
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =    68.00  DOWNSTREAM(FEET) =    66.60
   FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.2 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   5.67
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       1.75
   PIPE TRAVEL TIME(MIN.) =   0.19   Tc(MIN.) =  10.80
   LONGEST FLOWPATH FROM NODE       1.00 TO NODE      40.00 =   372.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      40.00 TO NODE      40.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  3
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
   TIME OF CONCENTRATION(MIN.) =  10.80
   RAINFALL INTENSITY(INCH/HR) =   4.00
   AREA-AVERAGED Fm(INCH/HR) =  0.07
   AREA-AVERAGED Fp(INCH/HR) =  0.20
   AREA-AVERAGED Ap =  0.37
   EFFECTIVE STREAM AREA(ACRES) =    0.49
   TOTAL STREAM AREA(ACRES) =    0.49
   PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.75

 ****************************************************************************
   FLOW PROCESS FROM NODE       5.00 TO NODE      45.00 IS CODE =  21
 ----------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
 ============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
   ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.18

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.178
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.403
   SUBAREA Tc AND LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D        0.40      0.20       0.40    75    9.18
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA RUNOFF(CFS) =       1.56
   TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =       1.56

 ****************************************************************************
   FLOW PROCESS FROM NODE      45.00 TO NODE      46.00 IS CODE =  62
 ----------------------------------------------------------------------------
```

```
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ================================================================================
   UPSTREAM ELEVATION(FEET) =    68.18  DOWNSTREAM ELEVATION(FEET) =    67.50
   STREET LENGTH(FEET) =     57.00   CURB HEIGHT(INCHES) =  4.8
   STREET HALFWIDTH(FEET) = 15.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.020
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        1.75
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.26
     HALFSTREET FLOOD WIDTH(FEET) =     8.63
     AVERAGE FLOW VELOCITY(FEET/SEC.) =     2.17
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     0.57
   STREET FLOW TRAVEL TIME(MIN.) =    0.44   Tc(MIN.) =    9.62
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.274
   SUBAREA LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D         0.10      0.20       0.40     75
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =     0.38
   EFFECTIVE AREA(ACRES) =     0.50     AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =     0.50         PEAK FLOW RATE(CFS) =        1.89

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =    8.91
   FLOW VELOCITY(FEET/SEC.) =  2.21   DEPTH*VELOCITY(FT*FT/SEC.) =    0.59
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      46.00 =    310.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      46.00 TO NODE      46.00 IS CODE =  81
 ----------------------------------------------------------------------------
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
 ============================================================================
   MAINLINE Tc(MIN) =    9.62
   * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.274
   SUBAREA LOSS RATE DATA(AMC  II):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   APARTMENTS                  D         0.07      0.20       0.20     75
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.20
   SUBAREA AREA(ACRES) =     0.07       SUBAREA RUNOFF(CFS) =     0.27
   EFFECTIVE AREA(ACRES) =     0.57     AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.38
   TOTAL AREA(ACRES) =     0.57         PEAK FLOW RATE(CFS) =        2.15

 ****************************************************************************
   FLOW PROCESS FROM NODE      46.00 TO NODE      40.00 IS CODE =  31
 ----------------------------------------------------------------------------
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```



```
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     67.50  DOWNSTREAM(FEET) =     66.60
   FLOW LENGTH(FEET) =     40.00   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH)  INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS    4.6 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =    6.14
   ESTIMATED PIPE DIAMETER(INCH) =  18.00     NUMBER OF PIPES =    1
   PIPE-FLOW(CFS) =        2.15
   PIPE TRAVEL TIME(MIN.) =    0.11    Tc(MIN.) =    9.72
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      40.00 =    350.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      40.00 TO NODE      40.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
   >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  3
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
   TIME OF CONCENTRATION(MIN.) =    9.72
   RAINFALL INTENSITY(INCH/HR) =    4.24
   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20
   AREA-AVERAGED Ap =  0.38
   EFFECTIVE STREAM AREA(ACRES) =     0.57
   TOTAL STREAM AREA(ACRES) =     0.57
   PEAK FLOW RATE(CFS) AT CONFLUENCE =        2.15

   ** CONFLUENCE DATA **
    STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
    NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
       1       8.68    9.58     4.285   0.20( 0.08) 0.40      2.3       25.00
       1       8.87   10.41     4.079   0.20( 0.08) 0.40      2.4       25.00
       1       8.90   10.60     4.040   0.20( 0.08) 0.40      2.5       21.00
       1       8.91   10.74     4.012   0.20( 0.08) 0.40      2.5       21.00
       1       8.86   11.20     3.920   0.20( 0.08) 0.40      2.5        5.00
       1       8.68   11.75     3.809   0.20( 0.08) 0.40      2.5        1.00
       2       1.75   10.80     4.000   0.20( 0.07) 0.37      0.5        1.00
       3       2.15    9.72     4.241   0.20( 0.08) 0.38      0.6        5.00

   RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
   CONFLUENCE FORMULA USED FOR  3 STREAMS.

   ** PEAK FLOW RATE TABLE **
    STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
    NUMBER    (CFS)  (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
       1      12.49    9.58     4.285   0.20( 0.08) 0.39      3.2       25.00
       2      12.54    9.72     4.241   0.20( 0.08) 0.39      3.3        5.00
       3      12.65   10.41     4.079   0.20( 0.08) 0.39      3.5       25.00
       4      12.68   10.60     4.040   0.20( 0.08) 0.39      3.5       21.00
       5      12.68   10.74     4.012   0.20( 0.08) 0.39      3.5       21.00
       6      12.68   10.80     4.000   0.20( 0.08) 0.39      3.5        1.00
       7      12.56   11.20     3.920   0.20( 0.08) 0.39      3.6        5.00
       8      12.28   11.75     3.809   0.20( 0.08) 0.39      3.6        1.00

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      12.68    Tc(MIN.) =     10.74
   EFFECTIVE AREA(ACRES) =      3.53    AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.39
   TOTAL AREA(ACRES) =       3.60
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      40.00 =    537.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      40.00 TO NODE      50.00 IS CODE =  31
```

```
--------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    66.60  DOWNSTREAM(FEET) =    65.30
  FLOW LENGTH(FEET) =   330.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.00
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     12.68
  PIPE TRAVEL TIME(MIN.) =   1.10    Tc(MIN.) =  11.84
  LONGEST FLOWPATH FROM NODE      5.00 TO NODE     50.00 =   867.00 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      3.60  TC(MIN.) =     11.84
  EFFECTIVE AREA(ACRES) =      3.53  AREA-AVERAGED Fm(INCH/HR)=  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.39
  PEAK FLOW RATE(CFS)   =     12.68

  ** PEAK FLOW RATE TABLE **
   STREAM     Q      Tc   Intensity   Fp(Fm)      Ap    Ae     HEADWATER
   NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)        (ACRES)    NODE
      1     12.49  10.68    4.024  0.20( 0.08) 0.39     3.2       25.00
      2     12.54  10.83    3.995  0.20( 0.08) 0.39     3.3        5.00
      3     12.65  11.51    3.859  0.20( 0.08) 0.39     3.5       25.00
      4     12.68  11.70    3.820  0.20( 0.08) 0.39     3.5       21.00
      5     12.68  11.84    3.792  0.20( 0.08) 0.39     3.5       21.00
      6     12.68  11.90    3.780  0.20( 0.08) 0.39     3.5        1.00
      7     12.56  12.30    3.700  0.20( 0.08) 0.39     3.6        5.00
      8     12.28  12.86    3.608  0.20( 0.08) 0.39     3.6        1.00
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

APPENDIX C: 2-YEAR ANALYSIS FOR EXISTING AND PROPOSED

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
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             Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\EX-A-2.DAT
  TIME/DATE OF STUDY: 10:48 06/13/2011
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-   HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     10.0    0.020/0.020/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.70  DOWNSTREAM(FEET) =     69.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.484
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.796
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.36      0.20        0.10     57    7.48
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =       0.58
  TOTAL AREA(ACRES) =       0.36   PEAK FLOW RATE(CFS) =       0.58
```



```
************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       2.00 IS CODE =  81
------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
  MAINLINE Tc(MIN) =    7.48
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.796
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN
  COMMERCIAL                 D        0.25      0.20        0.10     57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.25   SUBAREA RUNOFF(CFS) =     0.40
  EFFECTIVE AREA(ACRES) =     0.61   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     0.61   PEAK FLOW RATE(CFS) =       0.97

************************************************************************
  FLOW PROCESS FROM NODE       2.00 TO NODE       3.00 IS CODE =  91
------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
========================================================================
  UPSTREAM NODE ELEVATION(FEET) =     69.00
  DOWNSTREAM NODE ELEVATION(FEET) =     68.84
  CHANNEL LENGTH THRU SUBAREA(FEET) =    65.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.250
  PAVEMENT LIP(FEET) =  0.375   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =   0.70
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.742
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)   (DECIMAL)  CN
  COMMERCIAL                 D        0.44      0.20        0.10     57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.32
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.65
  AVERAGE FLOW DEPTH(FEET) =   0.62   FLOOD WIDTH(FEET) =    3.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.41   Tc(MIN.) =   7.89
  SUBAREA AREA(ACRES) =     0.44   SUBAREA RUNOFF(CFS) =     0.68
  EFFECTIVE AREA(ACRES) =     1.05   AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =     1.05   PEAK FLOW RATE(CFS) =       1.63

        NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL
        DEPTH EQUAL TO [GUTTER-HIKE + PAVEMENT LIP]

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.62   FLOOD WIDTH(FEET) =    3.00
  FLOW VELOCITY(FEET/SEC.) =   2.65   DEPTH*VELOCITY(FT*FT/SEC) =   1.66
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE       3.00 =   250.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE       3.00 TO NODE       4.00 IS CODE =  51
------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     68.84  DOWNSTREAM(FEET) =     68.56
  CHANNEL LENGTH THRU SUBAREA(FEET) =    70.00   CHANNEL SLOPE =  0.0040
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =   6.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
```

```
 CHANNEL FLOW THRU SUBAREA(CFS) =      1.63
 FLOW VELOCITY(FEET/SEC) =   1.99   FLOW DEPTH(FEET) =   0.37
 TRAVEL TIME(MIN.) =   0.59   Tc(MIN.) =   8.48
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =   320.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =   8.48
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.672
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        0.51      0.20       0.10    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.51      SUBAREA RUNOFF(CFS) =     0.76
 EFFECTIVE AREA(ACRES) =     1.56    AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     1.56        PEAK FLOW RATE(CFS) =       2.32

****************************************************************************
 FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     68.56
 DOWNSTREAM NODE ELEVATION(FEET) =     67.75
 CHANNEL LENGTH THRU SUBAREA(FEET) =   110.00
 "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.250
 PAVEMENT LIP(FEET) =  0.375   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
 MAXIMUM DEPTH(FEET) =   0.70
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.628
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        0.36      0.20       0.10    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      2.58
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.58
 AVERAGE FLOW DEPTH(FEET) =   0.62   FLOOD WIDTH(FEET) =    3.00
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.40   Tc(MIN.) =   8.88
 SUBAREA AREA(ACRES) =     0.36      SUBAREA RUNOFF(CFS) =     0.52
 EFFECTIVE AREA(ACRES) =     1.92    AREA-AVERAGED Fm(INCH/HR) =   0.02
 AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.10
 TOTAL AREA(ACRES) =     1.92        PEAK FLOW RATE(CFS) =       2.78

        NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL
        DEPTH EQUAL TO [GUTTER-HIKE + PAVEMENT LIP]

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.62   FLOOD WIDTH(FEET) =    3.00
 FLOW VELOCITY(FEET/SEC.) =   4.58   DEPTH*VELOCITY(FT*FT/SEC) =   2.86
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =   430.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
```



```
============================================================================
 UPSTREAM ELEVATION(FEET) =   67.75  DOWNSTREAM ELEVATION(FEET) =   67.44
 STREET LENGTH(FEET) =   195.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 30.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.78
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.46
  HALFSTREET FLOOD WIDTH(FEET) =   14.97
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.15
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.52
 STREET FLOW TRAVEL TIME(MIN.) =   2.84   Tc(MIN.) =  11.72
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.388
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        0.01      0.20       0.10    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.01      SUBAREA RUNOFF(CFS) =     0.01
 EFFECTIVE AREA(ACRES) =     1.93    AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     1.93        PEAK FLOW RATE(CFS) =       2.78
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.46   HALFSTREET FLOOD WIDTH(FEET) =  14.90
 FLOW VELOCITY(FEET/SEC.) =  1.15   DEPTH*VELOCITY(FT*FT/SEC.) =   0.53
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =   625.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =  11.72
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.388
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 D        0.74      0.20       0.10    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
 SUBAREA AREA(ACRES) =     0.74      SUBAREA RUNOFF(CFS) =     0.91
 EFFECTIVE AREA(ACRES) =     2.67    AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =     2.67        PEAK FLOW RATE(CFS) =       3.29
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =      2.67  TC(MIN.) =     11.72
 EFFECTIVE AREA(ACRES) =       2.67  AREA-AVERAGED Fm(INCH/HR)=  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.10
 PEAK FLOW RATE(CFS)    =      3.29
============================================================================
============================================================================
```

END OF RATIONAL METHOD ANALYSIS

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
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              Ver. 8.0  Release Date: 01/01/2001  License ID 1264

                          Analysis prepared by:

                              RBF Consulting
                            14725 Alton Parkway
                             Irvine, CA  92618


----------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\EX-B-2.DAT
  TIME/DATE OF STUDY: 10:55 06/13/2011
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   225.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.20  DOWNSTREAM(FEET) =     68.41

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.216
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.702
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 D        0.59      0.20       0.10    57    8.22
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA RUNOFF(CFS) =      0.89
  TOTAL AREA(ACRES) =      0.59   PEAK FLOW RATE(CFS) =      0.89
```



```
************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN) =   8.22
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.702
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        0.42      0.20       0.10    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.10
  SUBAREA AREA(ACRES) =     0.42     SUBAREA RUNOFF(CFS) =     0.64
  EFFECTIVE AREA(ACRES) =     1.01   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =     1.01       PEAK FLOW RATE(CFS) =       1.53
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =      1.01  TC(MIN.) =      8.22
  EFFECTIVE AREA(ACRES) =       1.01  AREA-AVERAGED Fm(INCH/HR)=  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  PEAK FLOW RATE(CFS)    =      1.53
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

****

NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS

Ver. 8.0 Release Date: 01/01/2001 License ID 1264

Analysis prepared by:

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

TOTAL 24-HOUR DURATION RAINFALL DEPTH = 2.05 (inches)

SOIL-COVER TYPE	AREA (Acres)	PERCENT OF PERVIOUS AREA	SCS CURVE NUMBER	LOSS RATE Fp(in./hr.)	YIELD
1	3.68	90.00	95.(98.)	0.200	0.761

TOTAL AREA (Acres) = 3.68

AREA-AVERAGED LOSS RATE, $\bar{Fm}$ (in./hr.) = 0.180

AREA-AVERAGED LOW LOSS FRACTION, $\bar{Y}$ = 0.239

1

****

SMALL AREA UNIT HYDROGRAPH MODEL

Ver. 8.0 Release Date: 01/01/2001 License ID 1264

Analysis prepared by:

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RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
TOTAL CATCHMENT AREA(ACRES) = 3.68
SOIL-LOSS RATE, Fm,(INCH/HR) = 0.180
LOW LOSS FRACTION = 0.239
TIME OF CONCENTRATION(MIN.) = 11.72
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.19
30-MINUTE POINT RAINFALL VALUE(INCHES) = 0.40
1-HOUR POINT RAINFALL VALUE(INCHES) = 0.53
3-HOUR POINT RAINFALL VALUE(INCHES) = 0.89
6-HOUR POINT RAINFALL VALUE(INCHES) = 1.22
24-HOUR POINT RAINFALL VALUE(INCHES) = 2.05

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 0.45
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 0.18

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TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	2.5	5.0	7.5	10.0
0.18	0.0006	0.08	Q	.	.	.	.
0.37	0.0019	0.08	Q	.	.	.	.
0.57	0.0032	0.08	Q	.	.	.	.
0.76	0.0045	0.08	Q	.	.	.	.
0.96	0.0059	0.08	Q	.	.	.	.
1.15	0.0072	0.08	Q	.	.	.	.
1.35	0.0086	0.08	Q	.	.	.	.
1.55	0.0100	0.09	Q	.	.	.	.
1.74	0.0113	0.09	Q	.	.	.	.
1.94	0.0127	0.09	Q	.	.	.	.
2.13	0.0141	0.09	Q	.	.	.	.
2.33	0.0156	0.09	Q	.	.	.	.
2.52	0.0170	0.09	Q	.	.	.	.
2.72	0.0184	0.09	Q	.	.	.	.
2.91	0.0199	0.09	Q	.	.	.	.
3.11	0.0214	0.09	Q	.	.	.	.
3.30	0.0229	0.09	Q	.	.	.	.
3.50	0.0244	0.09	Q	.	.	.	.
3.69	0.0259	0.09	Q	.	.	.	.
3.89	0.0274	0.09	Q	.	.	.	.
4.08	0.0289	0.10	Q	.	.	.	.
4.28	0.0305	0.10	Q	.	.	.	.
4.48	0.0321	0.10	Q	.	.	.	.

4.67	0.0337	0.10	Q	.	.	.	.
4.87	0.0353	0.10	Q	.	.	.	.
5.06	0.0369	0.10	Q	.	.	.	.
5.26	0.0385	0.10	Q	.	.	.	.
5.45	0.0402	0.10	Q	.	.	.	.
5.65	0.0419	0.11	Q	.	.	.	.
5.84	0.0436	0.11	Q	.	.	.	.
6.04	0.0453	0.11	Q	.	.	.	.
6.23	0.0471	0.11	Q	.	.	.	.
6.43	0.0488	0.11	Q	.	.	.	.
6.62	0.0506	0.11	Q	.	.	.	.
6.82	0.0524	0.11	Q	.	.	.	.
7.01	0.0543	0.11	Q	.	.	.	.
7.21	0.0561	0.12	Q	.	.	.	.
7.41	0.0580	0.12	Q	.	.	.	.
7.60	0.0599	0.12	Q	.	.	.	.
7.80	0.0618	0.12	Q	.	.	.	.
7.99	0.0638	0.12	Q	.	.	.	.
8.19	0.0658	0.12	Q	.	.	.	.
8.38	0.0678	0.13	Q	.	.	.	.
8.58	0.0699	0.13	Q	.	.	.	.
8.77	0.0720	0.13	Q	.	.	.	.
8.97	0.0741	0.13	Q	.	.	.	.
9.16	0.0763	0.14	Q	.	.	.	.
9.36	0.0785	0.14	Q	.	.	.	.
9.55	0.0807	0.14	Q	.	.	.	.
9.75	0.0830	0.14	Q	.	.	.	.
9.94	0.0853	0.15	Q	.	.	.	.
10.14	0.0877	0.15	Q	.	.	.	.
10.34	0.0901	0.15	Q	.	.	.	.
10.53	0.0926	0.15	Q	.	.	.	.
10.73	0.0951	0.16	Q	.	.	.	.
10.92	0.0977	0.16	Q	.	.	.	.
11.12	0.1004	0.17	Q	.	.	.	.
11.31	0.1031	0.17	Q	.	.	.	.
11.51	0.1059	0.18	Q	.	.	.	.
11.70	0.1087	0.18	Q	.	.	.	.
11.90	0.1116	0.19	Q	.	.	.	.
12.09	0.1147	0.19	Q	.	.	.	.
12.29	0.1181	0.24	Q	.	.	.	.
12.48	0.1220	0.24	Q	.	.	.	.
12.68	0.1260	0.25	.Q	.	.	.	.
12.87	0.1301	0.26	.Q	.	.	.	.
13.07	0.1344	0.27	.Q	.	.	.	.
13.27	0.1388	0.28	.Q	.	.	.	.
13.46	0.1434	0.29	.Q	.	.	.	.
13.66	0.1481	0.30	.Q	.	.	.	.
13.85	0.1531	0.32	.Q	.	.	.	.
14.05	0.1583	0.33	.Q	.	.	.	.
14.24	0.1639	0.36	.Q	.	.	.	.
14.44	0.1699	0.38	.Q	.	.	.	.
14.63	0.1762	0.41	.Q	.	.	.	.
14.83	0.1830	0.43	.Q	.	.	.	.
15.02	0.1904	0.48	.Q	.	.	.	.
15.22	0.1985	0.52	. Q	.	.	.	.
15.41	0.2074	0.60	. Q	.	.	.	.
15.61	0.2170	0.59	. Q	.	.	.	.
15.80	0.2286	0.85	. Q	.	.	.	.
16.00	0.2448	1.17	. Q	.	.	.	.
16.20	0.2931	4.82	.	.	Q.	.	.
16.39	0.3375	0.68	. Q	.	.	.	.
16.59	0.3475	0.56	. Q	.	.	.	.
16.78	0.3557	0.45	.Q	.	.	.	.
16.98	0.3625	0.39	.Q	.	.	.	.

17.17	0.3685	0.34	.Q	.	.	.	.
17.37	0.3737	0.31	.Q	.	.	.	.
17.56	0.3785	0.28	.Q	.	.	.	.
17.76	0.3829	0.26	.Q	.	.	.	.
17.95	0.3870	0.25	Q	.	.	.	.
18.15	0.3908	0.22	Q	.	.	.	.
18.34	0.3941	0.18	Q	.	.	.	.
18.54	0.3969	0.17	Q	.	.	.	.
18.73	0.3997	0.16	Q	.	.	.	.
18.93	0.4022	0.16	Q	.	.	.	.
19.13	0.4047	0.15	Q	.	.	.	.
19.32	0.4071	0.14	Q	.	.	.	.
19.52	0.4094	0.14	Q	.	.	.	.
19.71	0.4116	0.13	Q	.	.	.	.
19.91	0.4137	0.13	Q	.	.	.	.
20.10	0.4158	0.13	Q	.	.	.	.
20.30	0.4178	0.12	Q	.	.	.	.
20.49	0.4197	0.12	Q	.	.	.	.
20.69	0.4216	0.12	Q	.	.	.	.
20.88	0.4234	0.11	Q	.	.	.	.
21.08	0.4252	0.11	Q	.	.	.	.
21.27	0.4270	0.11	Q	.	.	.	.
21.47	0.4287	0.10	Q	.	.	.	.
21.66	0.4303	0.10	Q	.	.	.	.
21.86	0.4319	0.10	Q	.	.	.	.
22.06	0.4335	0.10	Q	.	.	.	.
22.25	0.4351	0.10	Q	.	.	.	.
22.45	0.4366	0.09	Q	.	.	.	.
22.64	0.4381	0.09	Q	.	.	.	.
22.84	0.4396	0.09	Q	.	.	.	.
23.03	0.4410	0.09	Q	.	.	.	.
23.23	0.4425	0.09	Q	.	.	.	.
23.42	0.4439	0.09	Q	.	.	.	.
23.62	0.4452	0.08	Q	.	.	.	.
23.81	0.4466	0.08	Q	.	.	.	.
24.01	0.4479	0.08	Q	.	.	.	.
24.20	0.4486	0.00	Q	.	.	.	.

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            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
               (Reference: 1986 OCEMA HYDROLOGY CRITERION)
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                          Analysis prepared by:

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------------------------------------------------------------------------
  FILE NAME: H:\PDATA\10108016\CALCS\LAND\HYDRO\PROP-2.DAT
  TIME/DATE OF STUDY: 10:57 06/13/2011
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)      (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   15.0       5.0    0.020/0.020/0.020   0.40    1.00 0.0312 0.080 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

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  FLOW PROCESS FROM NODE       1.00 TO NODE       2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   192.00
  ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.167
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.598
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.24      0.20       0.40    57    9.17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA RUNOFF(CFS) =      0.33
  TOTAL AREA(ACRES) =      0.24   PEAK FLOW RATE(CFS) =      0.33
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  FLOW PROCESS FROM NODE       2.00 TO NODE      10.00 IS CODE =  62
------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
========================================================================
  UPSTREAM ELEVATION(FEET) =    68.50  DOWNSTREAM ELEVATION(FEET) =    67.90
  STREET LENGTH(FEET) =   164.00   CURB HEIGHT(INCHES) =  4.8
  STREET HALFWIDTH(FEET) = 15.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.46
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.22
    HALFSTREET FLOOD WIDTH(FEET) =    6.31
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.01
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.22
  STREET FLOW TRAVEL TIME(MIN.) =   2.71   Tc(MIN.) =  11.88
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.377
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"       D        0.23      0.20       0.40    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.27
  EFFECTIVE AREA(ACRES) =    0.47    AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =    0.47        PEAK FLOW RATE(CFS) =       0.55

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.23   HALFSTREET FLOOD WIDTH(FEET) =   6.80
  FLOW VELOCITY(FEET/SEC.) =  1.05   DEPTH*VELOCITY(FT*FT/SEC.) =   0.24
  LONGEST FLOWPATH FROM NODE       1.00 TO NODE      10.00 =   356.00 FEET.

************************************************************************
  FLOW PROCESS FROM NODE      10.00 TO NODE      10.00 IS CODE =   1
------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  11.88
  RAINFALL INTENSITY(INCH/HR) =   1.38
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =    0.47
  TOTAL STREAM AREA(ACRES) =    0.47
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.55

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  FLOW PROCESS FROM NODE       5.00 TO NODE       6.00 IS CODE =  21
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>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.18

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.178
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.597
SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.39      0.20       0.40    57    9.18
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA RUNOFF(CFS) =       0.53
TOTAL AREA(ACRES) =       0.39   PEAK FLOW RATE(CFS) =       0.53

**************************************************************************
FLOW PROCESS FROM NODE       6.00 TO NODE      10.00 IS CODE =  62
--------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==========================================================================
UPSTREAM ELEVATION(FEET) =   68.18  DOWNSTREAM ELEVATION(FEET) =   67.90
STREET LENGTH(FEET) =   112.00   CURB HEIGHT(INCHES) =  4.8
STREET HALFWIDTH(FEET) = 15.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.020
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.65
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.25
  HALFSTREET FLOOD WIDTH(FEET) =    7.93
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.94
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.23
STREET FLOW TRAVEL TIME(MIN.) =   1.99   Tc(MIN.) =  11.16
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.428
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    57
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =    0.19      SUBAREA RUNOFF(CFS) =    0.23
EFFECTIVE AREA(ACRES) =    0.58    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =    0.58        PEAK FLOW RATE(CFS) =       0.70

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.25   HALFSTREET FLOOD WIDTH(FEET) =   8.14
FLOW VELOCITY(FEET/SEC.) =  0.97   DEPTH*VELOCITY(FT*FT/SEC.) =   0.25
LONGEST FLOWPATH FROM NODE       5.00 TO NODE      10.00 =   365.00 FEET.

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FLOW PROCESS FROM NODE      10.00 TO NODE      10.00 IS CODE =   1
--------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==========================================================================
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TIME OF CONCENTRATION(MIN.) =  11.16
RAINFALL INTENSITY(INCH/HR) =   1.43
AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20
AREA-AVERAGED Ap =  0.40
EFFECTIVE STREAM AREA(ACRES) =    0.58
TOTAL STREAM AREA(ACRES) =    0.58
PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.70

** CONFLUENCE DATA **
 STREAM     Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
 NUMBER   (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1      0.55  11.88     1.377   0.20( 0.08) 0.40      0.5        1.00
    2      0.70  11.16     1.428   0.20( 0.08) 0.40      0.6        5.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR  2 STREAMS.

** PEAK FLOW RATE TABLE **
 STREAM     Q      Tc    Intensity   Fp(Fm)      Ap    Ae      HEADWATER
 NUMBER   (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1      1.24  11.16     1.428   0.20( 0.08) 0.40      1.0        5.00
    2      1.23  11.88     1.377   0.20( 0.08) 0.40      1.0        1.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      1.24    Tc(MIN.) =    11.16
EFFECTIVE AREA(ACRES) =     1.02   AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =      1.05
LONGEST FLOWPATH FROM NODE       5.00 TO NODE      10.00 =   365.00 FEET.

**************************************************************************
FLOW PROCESS FROM NODE      10.00 TO NODE      20.00 IS CODE =  31
--------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==========================================================================
ELEVATION DATA: UPSTREAM(FEET) =    67.90  DOWNSTREAM(FEET) =    67.60
FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.013
ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.3 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   3.82
ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =      1.24
PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =  11.30
LONGEST FLOWPATH FROM NODE       5.00 TO NODE      20.00 =   397.00 FEET.

**************************************************************************
FLOW PROCESS FROM NODE      20.00 TO NODE      20.00 IS CODE =   1
--------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
TOTAL NUMBER OF STREAMS =  3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
TIME OF CONCENTRATION(MIN.) =  11.30
RAINFALL INTENSITY(INCH/HR) =   1.42
AREA-AVERAGED Fm(INCH/HR) =  0.08
```

```
AREA-AVERAGED Fp(INCH/HR) =  0.20
AREA-AVERAGED Ap =  0.40
EFFECTIVE STREAM AREA(ACRES) =    1.02
TOTAL STREAM AREA(ACRES) =    1.05
PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.24

****************************************************************************
FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  21
----------------------------------------------------------------------------
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.36

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.709
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.646
SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    57    8.71
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA RUNOFF(CFS) =      0.31
TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.31

****************************************************************************
FLOW PROCESS FROM NODE     22.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
UPSTREAM ELEVATION(FEET) =   68.36  DOWNSTREAM ELEVATION(FEET) =   67.90
STREET LENGTH(FEET) =   126.00   CURB HEIGHT(INCHES) =  4.8
STREET HALFWIDTH(FEET) = 15.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.020
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.43
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.21
  HALFSTREET FLOOD WIDTH(FEET) =    6.10
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.99
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.21
STREET FLOW TRAVEL TIME(MIN.) =   2.13   Tc(MIN.) =  10.84
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.452
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    57
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.23
EFFECTIVE AREA(ACRES) =     0.41    AREA-AVERAGED Fm(INCH/HR) =  0.08
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AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =     0.41         PEAK FLOW RATE(CFS) =       0.51

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.22   HALFSTREET FLOOD WIDTH(FEET) =   6.52
FLOW VELOCITY(FEET/SEC.) =  1.04   DEPTH*VELOCITY(FT*FT/SEC.) =   0.23
LONGEST FLOWPATH FROM NODE     21.00 TO NODE     20.00 =   312.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TIME OF CONCENTRATION(MIN.) =  10.84
RAINFALL INTENSITY(INCH/HR) =   1.45
AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20
AREA-AVERAGED Ap =  0.40
EFFECTIVE STREAM AREA(ACRES) =    0.41
TOTAL STREAM AREA(ACRES) =    0.41
PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.51

****************************************************************************
FLOW PROCESS FROM NODE     25.00 TO NODE     26.00 IS CODE =  21
----------------------------------------------------------------------------
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
ELEVATION DATA: UPSTREAM(FEET) =     69.00  DOWNSTREAM(FEET) =     68.04

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.644
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.653
SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    57    8.64
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA RUNOFF(CFS) =      0.31
TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.31

****************************************************************************
FLOW PROCESS FROM NODE     26.00 TO NODE     20.00 IS CODE =  62
----------------------------------------------------------------------------
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
UPSTREAM ELEVATION(FEET) =   68.04  DOWNSTREAM ELEVATION(FEET) =   67.90
STREET LENGTH(FEET) =    78.00   CURB HEIGHT(INCHES) =  4.8
STREET HALFWIDTH(FEET) = 15.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.020
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199
```

```
 **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.38
 STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
 STREET FLOW DEPTH(FEET) =  0.23
 HALFSTREET FLOOD WIDTH(FEET) =    6.73
 AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.74
 PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.17
STREET FLOW TRAVEL TIME(MIN.) =   1.75   Tc(MIN.) =  10.40
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.487
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"8-10 DWELLINGS/ACRE"       D        0.11      0.20       0.40    57
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
SUBAREA AREA(ACRES) =     0.11      SUBAREA RUNOFF(CFS) =     0.14
EFFECTIVE AREA(ACRES) =     0.33    AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
TOTAL AREA(ACRES) =     0.33        PEAK FLOW RATE(CFS) =       0.42

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.23   HALFSTREET FLOOD WIDTH(FEET) =   7.01
FLOW VELOCITY(FEET/SEC.) =  0.76   DEPTH*VELOCITY(FT*FT/SEC.) =   0.17
LONGEST FLOWPATH FROM NODE     25.00 TO NODE     20.00 =   263.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.40
 RAINFALL INTENSITY(INCH/HR) =   1.49
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    0.33
 TOTAL STREAM AREA(ACRES) =    0.33
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.42

 ** CONFLUENCE DATA **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)       (ACRES)    NODE
     1      1.24  11.30    1.417  0.20( 0.08) 0.40     1.0       5.00
     1      1.23  12.02    1.368  0.20( 0.08) 0.40     1.0       1.00
     2      0.51  10.84    1.452  0.20( 0.08) 0.40     0.4      21.00
     3      0.42  10.40    1.487  0.20( 0.08) 0.40     0.3      25.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  3 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM     Q     Tc   Intensity   Fp(Fm)     Ap   Ae     HEADWATER
  NUMBER   (CFS) (MIN.) (INCH/HR) (INCH/HR)       (ACRES)    NODE
     1      2.12  10.40    1.487  0.20( 0.08) 0.40     1.7      25.00
     2      2.13  10.84    1.452  0.20( 0.08) 0.40     1.7      21.00
     3      2.13  11.30    1.417  0.20( 0.08) 0.40     1.8       5.00
     4      2.08  12.02    1.368  0.20( 0.08) 0.40     1.8       1.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      2.13    Tc(MIN.) =    10.84
```



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 EFFECTIVE AREA(ACRES) =     1.72   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      1.79
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     20.00 =   397.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.90  DOWNSTREAM(FEET) =    66.80
 FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.57
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      2.13
 PIPE TRAVEL TIME(MIN.) =   0.40    Tc(MIN.) =  11.24
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     21.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
 ELEVATION DATA: UPSTREAM(FEET) =    69.30  DOWNSTREAM(FEET) =    68.39

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.765
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.640
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    57    8.77
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA RUNOFF(CFS) =      0.31
 TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.31

****************************************************************************
 FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =    68.39  DOWNSTREAM ELEVATION(FEET) =    67.80
 STREET LENGTH(FEET) =   140.00   CURB HEIGHT(INCHES) =  4.8
 STREET HALFWIDTH(FEET) = 15.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
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 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.44
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.21
   HALFSTREET FLOOD WIDTH(FEET) =    5.96
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.05
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.22
 STREET FLOW TRAVEL TIME(MIN.) =   2.22   Tc(MIN.) =  10.98
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.441
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.21      0.20       0.40    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA AREA(ACRES) =     0.21      SUBAREA RUNOFF(CFS) =     0.26
 EFFECTIVE AREA(ACRES) =     0.43    AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =     0.43        PEAK FLOW RATE(CFS) =       0.53

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.22   HALFSTREET FLOOD WIDTH(FEET) =   6.45
 FLOW VELOCITY(FEET/SEC.) =  1.10   DEPTH*VELOCITY(FT*FT/SEC.) =   0.24
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     32.00 =   326.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  10.98
 RAINFALL INTENSITY(INCH/HR) =   1.44
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    0.43
 TOTAL STREAM AREA(ACRES) =    0.43
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.53

****************************************************************************
 FLOW PROCESS FROM NODE     25.00 TO NODE     36.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   184.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.00  DOWNSTREAM(FEET) =     68.04

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.616
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.656
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.22      0.20       0.40    57    8.62
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
```



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 SUBAREA RUNOFF(CFS) =      0.31
 TOTAL AREA(ACRES) =      0.22   PEAK FLOW RATE(CFS) =      0.31

****************************************************************************
 FLOW PROCESS FROM NODE     36.00 TO NODE     32.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.04  DOWNSTREAM ELEVATION(FEET) =   67.80
 STREET LENGTH(FEET) =    64.00   CURB HEIGHT(INCHES) =  4.8
 STREET HALFWIDTH(FEET) = 15.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.38
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.20
   HALFSTREET FLOOD WIDTH(FEET) =    5.68
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.99
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.20
 STREET FLOW TRAVEL TIME(MIN.) =   1.08   Tc(MIN.) =   9.70
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.548
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.10      0.20       0.40    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA AREA(ACRES) =     0.10      SUBAREA RUNOFF(CFS) =     0.13
 EFFECTIVE AREA(ACRES) =     0.32    AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =     0.32        PEAK FLOW RATE(CFS) =       0.42

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.21   HALFSTREET FLOOD WIDTH(FEET) =   6.03
 FLOW VELOCITY(FEET/SEC.) =  1.00   DEPTH*VELOCITY(FT*FT/SEC.) =   0.21
 LONGEST FLOWPATH FROM NODE     25.00 TO NODE     32.00 =   248.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   9.70
 RAINFALL INTENSITY(INCH/HR) =   1.55
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    0.32
 TOTAL STREAM AREA(ACRES) =    0.32
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.42
```

```
 ** CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1       0.53  10.98     1.441   0.20( 0.08) 0.40      0.4       21.00
     2       0.42   9.70     1.548   0.20( 0.08) 0.40      0.3       25.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1       0.92   9.70     1.548   0.20( 0.08) 0.40      0.7       25.00
     2       0.92  10.98     1.441   0.20( 0.08) 0.40      0.8       21.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      0.92    Tc(MIN.) =      9.70
 EFFECTIVE AREA(ACRES) =      0.70   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20   AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =       0.75
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     32.00 =   326.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     30.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    67.80  DOWNSTREAM(FEET) =    66.80
 FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.07
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      0.92
 PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   9.72
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     30.00 =   336.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1       0.92   9.72     1.546   0.20( 0.08) 0.40      0.7       25.00
     2       0.92  11.00     1.439   0.20( 0.08) 0.40      0.8       21.00
 LONGEST FLOWPATH FROM NODE     21.00 TO NODE     30.00 =   336.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1       2.12  10.80     1.455   0.20( 0.08) 0.40      1.7       25.00
     2       2.13  11.24     1.422   0.20( 0.08) 0.40      1.7       21.00
     3       2.13  11.70     1.389   0.20( 0.08) 0.40      1.8        5.00
     4       2.08  12.42     1.343   0.20( 0.08) 0.40      1.8        1.00
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
  NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1       2.95   9.72     1.546   0.20( 0.08) 0.40      2.2       25.00
```



```
     2       3.03  10.80     1.455   0.20( 0.08) 0.40      2.4       25.00
     3       3.04  11.00     1.439   0.20( 0.08) 0.40      2.4       21.00
     4       3.04  11.24     1.422   0.20( 0.08) 0.40      2.5       21.00
     5       3.01  11.70     1.389   0.20( 0.08) 0.40      2.5        5.00
     6       2.94  12.42     1.343   0.20( 0.08) 0.40      2.5        1.00
   TOTAL AREA(ACRES) =      2.54

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      3.04  Tc(MIN.) =   11.004
 EFFECTIVE AREA(ACRES) =      2.44  AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =      2.54
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     30.00 =   507.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     30.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     40.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    66.80  DOWNSTREAM(FEET) =    66.60
 FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.36
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      3.04
 PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =  11.12
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     40.00 =   537.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     40.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  11.12
 RAINFALL INTENSITY(INCH/HR) =   1.43
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.40
 EFFECTIVE STREAM AREA(ACRES) =    2.44
 TOTAL STREAM AREA(ACRES) =    2.54
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.04

****************************************************************************
 FLOW PROCESS FROM NODE      1.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   192.00
 ELEVATION DATA: UPSTREAM(FEET) =     69.30  DOWNSTREAM(FEET) =     68.53

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.237
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.591
```

```
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.23      0.20       0.40    57    9.24
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA RUNOFF(CFS) =      0.31
 TOTAL AREA(ACRES) =      0.23   PEAK FLOW RATE(CFS) =      0.31

****************************************************************************
 FLOW PROCESS FROM NODE     41.00 TO NODE     42.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =   68.53  DOWNSTREAM ELEVATION(FEET) =   68.00
 STREET LENGTH(FEET) =   115.00   CURB HEIGHT(INCHES) =  4.8
 STREET HALFWIDTH(FEET) = 15.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL) =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL) =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0199

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      0.43
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.21
   HALFSTREET FLOOD WIDTH(FEET) =    5.75
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.10
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.23
 STREET FLOW TRAVEL TIME(MIN.) =   1.75   Tc(MIN.) =  10.98
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.441
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.19      0.20       0.40    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA AREA(ACRES) =     0.19      SUBAREA RUNOFF(CFS) =     0.23
 EFFECTIVE AREA(ACRES) =     0.42    AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
 TOTAL AREA(ACRES) =     0.42         PEAK FLOW RATE(CFS) =      0.51

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.22   HALFSTREET FLOOD WIDTH(FEET) =   6.24
 FLOW VELOCITY(FEET/SEC.) =  1.14   DEPTH*VELOCITY(FT*FT/SEC.) =   0.25
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE     42.00 =   307.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     42.00 TO NODE     42.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN) =  10.98
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.441
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
```



```
 APARTMENTS                  D        0.07      0.20       0.20    57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.20
 SUBAREA AREA(ACRES) =     0.07      SUBAREA RUNOFF(CFS) =     0.09
 EFFECTIVE AREA(ACRES) =     0.49   AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.37
 TOTAL AREA(ACRES) =     0.49        PEAK FLOW RATE(CFS) =      0.60

****************************************************************************
 FLOW PROCESS FROM NODE     42.00 TO NODE     40.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    68.00  DOWNSTREAM(FEET) =    66.60
 FLOW LENGTH(FEET) =    65.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.17
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      0.60
 PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =  11.24
 LONGEST FLOWPATH FROM NODE      1.00 TO NODE     40.00 =   372.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     40.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  3
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =  11.24
 RAINFALL INTENSITY(INCH/HR) =   1.42
 AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.20
 AREA-AVERAGED Ap =  0.37
 EFFECTIVE STREAM AREA(ACRES) =    0.49
 TOTAL STREAM AREA(ACRES) =    0.49
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.60

****************************************************************************
 FLOW PROCESS FROM NODE      5.00 TO NODE     45.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
 ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.18

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.178
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.597
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "8-10 DWELLINGS/ACRE"       D        0.40      0.20       0.40    57    9.18
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
 SUBAREA RUNOFF(CFS) =      0.55
 TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      0.55

****************************************************************************
 FLOW PROCESS FROM NODE     45.00 TO NODE     46.00 IS CODE =  62
```

```
 ----------------------------------------------------------------------------
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
 ============================================================================
   UPSTREAM ELEVATION(FEET) =    68.18  DOWNSTREAM ELEVATION(FEET) =    67.50
   STREET LENGTH(FEET) =     57.00   CURB HEIGHT(INCHES) =  4.8
   STREET HALFWIDTH(FEET) = 15.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =    5.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.020
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =    0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =    0.0199

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        0.61
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.20
     HALFSTREET FLOOD WIDTH(FEET) =     5.46
     AVERAGE FLOW VELOCITY(FEET/SEC.) =     1.70
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     0.34
   STREET FLOW TRAVEL TIME(MIN.) =    0.56   Tc(MIN.) =    9.74
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.544
   SUBAREA LOSS RATE DATA(AMC   I ):
    DEVELOPMENT TYPE/       SCS SOIL    AREA       Fp          Ap      SCS
        LAND USE             GROUP    (ACRES)   (INCH/HR)   (DECIMAL)  CN
   RESIDENTIAL
   "8-10 DWELLINGS/ACRE"       D         0.10       0.20       0.40     57
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.40
   SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =     0.13
   EFFECTIVE AREA(ACRES) =     0.50     AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.40
   TOTAL AREA(ACRES) =     0.50         PEAK FLOW RATE(CFS) =        0.66

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =    5.61
   FLOW VELOCITY(FEET/SEC.) =  1.75   DEPTH*VELOCITY(FT*FT/SEC.) =    0.36
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      46.00 =   310.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      46.00 TO NODE      46.00 IS CODE =  81
 ----------------------------------------------------------------------------
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
 ============================================================================
   MAINLINE Tc(MIN) =    9.74
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.544
   SUBAREA LOSS RATE DATA(AMC   I ):
    DEVELOPMENT TYPE/       SCS SOIL    AREA       Fp          Ap      SCS
        LAND USE             GROUP    (ACRES)   (INCH/HR)   (DECIMAL)  CN
   APARTMENTS                  D         0.07       0.20       0.20     57
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.20
   SUBAREA AREA(ACRES) =     0.07       SUBAREA RUNOFF(CFS) =     0.09
   EFFECTIVE AREA(ACRES) =     0.57   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.38
   TOTAL AREA(ACRES) =      0.57       PEAK FLOW RATE(CFS) =        0.75

 ****************************************************************************
   FLOW PROCESS FROM NODE      46.00 TO NODE      40.00 IS CODE =  31
 ----------------------------------------------------------------------------
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```



```
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     67.50  DOWNSTREAM(FEET) =     66.60
   FLOW LENGTH(FEET) =     40.00   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS    2.7 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =    4.52
   ESTIMATED PIPE DIAMETER(INCH) =  18.00     NUMBER OF PIPES =    1
   PIPE-FLOW(CFS) =       0.75
   PIPE TRAVEL TIME(MIN.) =    0.15     Tc(MIN.) =    9.88
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      40.00 =   350.00 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      40.00 TO NODE      40.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
   >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  3
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
   TIME OF CONCENTRATION(MIN.) =    9.88
   RAINFALL INTENSITY(INCH/HR) =    1.53
   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20
   AREA-AVERAGED Ap =  0.38
   EFFECTIVE STREAM AREA(ACRES) =     0.57
   TOTAL STREAM AREA(ACRES) =     0.57
   PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.75

   ** CONFLUENCE DATA **
    STREAM     Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
    NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
       1       2.95   9.83     1.535   0.20( 0.08) 0.40      2.2       25.00
       1       3.03  10.91     1.446   0.20( 0.08) 0.40      2.4       25.00
       1       3.04  11.12     1.431   0.20( 0.08) 0.40      2.4       21.00
       1       3.04  11.35     1.414   0.20( 0.08) 0.40      2.5       21.00
       1       3.01  11.82     1.382   0.20( 0.08) 0.40      2.5        5.00
       1       2.94  12.54     1.335   0.20( 0.08) 0.40      2.5        1.00
       2       0.60  11.24     1.422   0.20( 0.07) 0.37      0.5        1.00
       3       0.75   9.88     1.531   0.20( 0.08) 0.38      0.6        5.00

   RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
   CONFLUENCE FORMULA USED FOR  3 STREAMS.

   ** PEAK FLOW RATE TABLE **
    STREAM     Q      Tc    Intensity    Fp(Fm)      Ap    Ae      HEADWATER
    NUMBER    (CFS)  (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)     NODE
       1       4.28   9.83     1.535   0.20( 0.08) 0.39      3.2       25.00
       2       4.28   9.88     1.531   0.20( 0.08) 0.39      3.2        5.00
       3       4.34  10.91     1.446   0.20( 0.08) 0.39      3.5       25.00
       4       4.34  11.12     1.431   0.20( 0.08) 0.39      3.5       21.00
       5       4.34  11.24     1.422   0.20( 0.08) 0.39      3.5        1.00
       6       4.33  11.35     1.414   0.20( 0.08) 0.39      3.5       21.00
       7       4.28  11.82     1.382   0.20( 0.08) 0.39      3.6        5.00
       8       4.15  12.54     1.335   0.20( 0.08) 0.39      3.6        1.00

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =       4.34     Tc(MIN.) =    11.12
   EFFECTIVE AREA(ACRES) =      3.49   AREA-AVERAGED Fm(INCH/HR) =  0.08
   AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.39
   TOTAL AREA(ACRES) =       3.60
   LONGEST FLOWPATH FROM NODE       5.00 TO NODE      40.00 =   537.00 FEET.

 ****************************************************************************
```

```
 FLOW PROCESS FROM NODE     40.00 TO NODE     50.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    66.60  DOWNSTREAM(FEET) =    65.30
 FLOW LENGTH(FEET) =   330.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   3.90
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      4.34
 PIPE TRAVEL TIME(MIN.) =   1.41    Tc(MIN.) =  12.53
 LONGEST FLOWPATH FROM NODE      5.00 TO NODE     50.00 =   867.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =      3.60  TC(MIN.) =     12.53
 EFFECTIVE AREA(ACRES) =      3.49  AREA-AVERAGED Fm(INCH/HR)=  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.39
 PEAK FLOW RATE(CFS)    =      4.34

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)      Ap   Ae      HEADWATER
  NUMBER    (CFS) (MIN.) (INCH/HR) (INCH/HR)         (ACRES)     NODE
     1      4.28  11.25    1.421  0.20( 0.08) 0.39      3.2       25.00
     2      4.28  11.30    1.418  0.20( 0.08) 0.39      3.2        5.00
     3      4.34  12.32    1.349  0.20( 0.08) 0.39      3.5       25.00
     4      4.34  12.53    1.336  0.20( 0.08) 0.39      3.5       21.00
     5      4.34  12.65    1.329  0.20( 0.08) 0.39      3.5        1.00
     6      4.33  12.76    1.322  0.20( 0.08) 0.39      3.5       21.00
     7      4.28  13.23    1.295  0.20( 0.08) 0.39      3.6        5.00
     8      4.15  13.96    1.255  0.20( 0.08) 0.39      3.6        1.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

****

NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS

Analysis prepared by:

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

TOTAL 24-HOUR DURATION RAINFALL DEPTH = 2.05 (inches)

SOIL-COVER TYPE	AREA (Acres)	PERCENT OF PERVIOUS AREA	SCS CURVE NUMBER	LOSS RATE Fp(in./hr.)	YIELD
1	3.68	60.00	57.(75.)	0.200	0.366

TOTAL AREA (Acres) = 3.68

AREA-AVERAGED LOSS RATE, $\bar{Fm}$ (in./hr.) = 0.120

AREA-AVERAGED LOW LOSS FRACTION, $\bar{Y}$ = 0.634

1

****

SMALL AREA UNIT HYDROGRAPH MODEL

Ver. 8.0 Release Date: 01/01/2001 License ID 1264

Analysis prepared by:

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
TOTAL CATCHMENT AREA(ACRES) = 3.68
SOIL-LOSS RATE, Fm,(INCH/HR) = 0.120
LOW LOSS FRACTION = 0.634
TIME OF CONCENTRATION(MIN.) = 12.53
RATIONAL METHOD PEAK FLOW RATE (DEFINED BY USER)
IS USED FOR SMALL AREA PEAK Q
ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 2
5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.19
30-MINUTE POINT RAINFALL VALUE(INCHES) = 0.40
1-HOUR POINT RAINFALL VALUE(INCHES) = 0.53
3-HOUR POINT RAINFALL VALUE(INCHES) = 0.89
6-HOUR POINT RAINFALL VALUE(INCHES) = 1.22
24-HOUR POINT RAINFALL VALUE(INCHES) = 2.05

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 0.27
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 0.36

****

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	2.5	5.0	7.5	10.0
0.13	0.0000	0.00	Q	.	.	.	.
0.34	0.0000	0.04	Q	.	.	.	.
0.55	0.0007	0.04	Q	.	.	.	.
0.76	0.0014	0.04	Q	.	.	.	.
0.96	0.0020	0.04	Q	.	.	.	.
1.17	0.0027	0.04	Q	.	.	.	.
1.38	0.0034	0.04	Q	.	.	.	.
1.59	0.0041	0.04	Q	.	.	.	.
1.80	0.0049	0.04	Q	.	.	.	.
2.01	0.0056	0.04	Q	.	.	.	.
2.22	0.0063	0.04	Q	.	.	.	.
2.43	0.0070	0.04	Q	.	.	.	.
2.63	0.0078	0.04	Q	.	.	.	.
2.84	0.0085	0.04	Q	.	.	.	.
3.05	0.0093	0.04	Q	.	.	.	.
3.26	0.0100	0.04	Q	.	.	.	.
3.47	0.0108	0.04	Q	.	.	.	.
3.68	0.0116	0.05	Q	.	.	.	.
3.89	0.0124	0.05	Q	.	.	.	.
4.10	0.0132	0.05	Q	.	.	.	.
4.31	0.0140	0.05	Q	.	.	.	.
4.51	0.0148	0.05	Q	.	.	.	.
4.72	0.0156	0.05	Q	.	.	.	.

4.93	0.0164	0.05	Q	.	.	.	.
5.14	0.0173	0.05	Q	.	.	.	.
5.35	0.0181	0.05	Q	.	.	.	.
5.56	0.0190	0.05	Q	.	.	.	.
5.77	0.0198	0.05	Q	.	.	.	.
5.98	0.0207	0.05	Q	.	.	.	.
6.18	0.0216	0.05	Q	.	.	.	.
6.39	0.0225	0.05	Q	.	.	.	.
6.60	0.0234	0.05	Q	.	.	.	.
6.81	0.0244	0.05	Q	.	.	.	.
7.02	0.0253	0.06	Q	.	.	.	.
7.23	0.0263	0.06	Q	.	.	.	.
7.44	0.0272	0.06	Q	.	.	.	.
7.65	0.0282	0.06	Q	.	.	.	.
7.86	0.0292	0.06	Q	.	.	.	.
8.06	0.0302	0.06	Q	.	.	.	.
8.27	0.0313	0.06	Q	.	.	.	.
8.48	0.0323	0.06	Q	.	.	.	.
8.69	0.0334	0.06	Q	.	.	.	.
8.90	0.0345	0.06	Q	.	.	.	.
9.11	0.0356	0.06	Q	.	.	.	.
9.32	0.0367	0.07	Q	.	.	.	.
9.53	0.0378	0.07	Q	.	.	.	.
9.74	0.0390	0.07	Q	.	.	.	.
9.94	0.0402	0.07	Q	.	.	.	.
10.15	0.0414	0.07	Q	.	.	.	.
10.36	0.0427	0.07	Q	.	.	.	.
10.57	0.0439	0.07	Q	.	.	.	.
10.78	0.0453	0.08	Q	.	.	.	.
10.99	0.0466	0.08	Q	.	.	.	.
11.20	0.0480	0.08	Q	.	.	.	.
11.41	0.0494	0.08	Q	.	.	.	.
11.61	0.0508	0.09	Q	.	.	.	.
11.82	0.0523	0.09	Q	.	.	.	.
12.03	0.0538	0.09	Q	.	.	.	.
12.24	0.0556	0.11	Q	.	.	.	.
12.45	0.0575	0.12	Q	.	.	.	.
12.66	0.0595	0.12	Q	.	.	.	.
12.87	0.0616	0.13	Q	.	.	.	.
13.08	0.0638	0.13	Q	.	.	.	.
13.29	0.0661	0.13	Q	.	.	.	.
13.49	0.0685	0.14	Q	.	.	.	.
13.70	0.0709	0.15	Q	.	.	.	.
13.91	0.0735	0.15	Q	.	.	.	.
14.12	0.0762	0.17	Q	.	.	.	.
14.33	0.0792	0.18	Q	.	.	.	.
14.54	0.0823	0.19	Q	.	.	.	.
14.75	0.0857	0.20	Q	.	.	.	.
14.96	0.0894	0.22	Q	.	.	.	.
15.16	0.0935	0.26	.Q	.	.	.	.
15.37	0.0989	0.37	.Q	.	.	.	.
15.58	0.1053	0.37	.Q	.	.	.	.
15.79	0.1143	0.67	. Q	.	.	.	.
16.00	0.1293	1.08	. Q	.	.	.	.
16.21	0.1761	4.34	.	.	Q	.	.
16.42	0.2175	0.46	.Q	.	.	.	.
16.63	0.2242	0.31	.Q	.	.	.	.
16.84	0.2287	0.21	Q	.	.	.	.
17.04	0.2321	0.18	Q	.	.	.	.
17.25	0.2350	0.16	Q	.	.	.	.
17.46	0.2376	0.14	Q	.	.	.	.
17.67	0.2399	0.13	Q	.	.	.	.
17.88	0.2421	0.12	Q	.	.	.	.
18.09	0.2442	0.11	Q	.	.	.	.

18.30	0.2459	0.09	Q	.	.	.	.
18.51	0.2474	0.08	Q	.	.	.	.
18.71	0.2488	0.08	Q	.	.	.	.
18.92	0.2502	0.08	Q	.	.	.	.
19.13	0.2514	0.07	Q	.	.	.	.
19.34	0.2527	0.07	Q	.	.	.	.
19.55	0.2538	0.07	Q	.	.	.	.
19.76	0.2550	0.06	Q	.	.	.	.
19.97	0.2560	0.06	Q	.	.	.	.
20.18	0.2571	0.06	Q	.	.	.	.
20.39	0.2581	0.06	Q	.	.	.	.
20.59	0.2591	0.06	Q	.	.	.	.
20.80	0.2601	0.05	Q	.	.	.	.
21.01	0.2610	0.05	Q	.	.	.	.
21.22	0.2619	0.05	Q	.	.	.	.
21.43	0.2628	0.05	Q	.	.	.	.
21.64	0.2636	0.05	Q	.	.	.	.
21.85	0.2645	0.05	Q	.	.	.	.
22.06	0.2653	0.05	Q	.	.	.	.
22.27	0.2661	0.05	Q	.	.	.	.
22.47	0.2669	0.05	Q	.	.	.	.
22.68	0.2676	0.04	Q	.	.	.	.
22.89	0.2684	0.04	Q	.	.	.	.
23.10	0.2691	0.04	Q	.	.	.	.
23.31	0.2699	0.04	Q	.	.	.	.
23.52	0.2706	0.04	Q	.	.	.	.
23.73	0.2713	0.04	Q	.	.	.	.
23.94	0.2720	0.04	Q	.	.	.	.
24.14	0.2726	0.04	Q	.	.	.	.
24.35	0.2730	0.00	Q	.	.	.	.

1

Water Quality Management Plan (WQMP)

for:

Harbor Blvd. / Merrimac Way Project

Harbor Blvd. And Merrimac Way, Costa Mesa

Tentative Tract Number 17423

Prepared for:

Waterpointe Homes
190 Newport Center Drive, Newport Beach, California 92660

Prepared by:

14725 Alton Parkway, Irvine, Ca 92618 949-472-3505

June 14, 2011

JN 10-108016

Owner's Certification Water Quality Management Plan (WQMP)

Project Name: Harbor Blvd. / Merrimac Way Project

Tract/Parcel Map Number: 17423

This Water Quality Management Plan (WQMP) has been prepared for Waterpointe Homes by RBF Consulting. The WQMP is intended to comply with the requirements of the City of Costa Mesa Jurisdictional Urban Runoff Management Program and Stormwater Ordinance, as well as the Municipal Stormwater Permit that requires the preparation of WQMPs for priority development projects. This WQMP is in support of Tract Map No. 17423.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this WQMP. The undersigned will ensure that this plan is carried out and amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region Stormwater Runoff Management Program. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Signed: _____

Name: Garrett Calacci

Title: President

Company: Waterpointe Homes

Address: 190 Newport Center Drive, Newport Beach, California 92660

Telephone #: 949-644-8900

Date: _____

Email Address: garrett@waterpointehomes.net

Table of Contents

Tables

Figures

Appendices

Preface

This document, based on the City of Costa Mesa WQMP template, has been reformatted to better coincide with the requirements set forth in the new stormwater permits (Santa Ana RWQCB, R8-2009-0030). The reformatting follows the *Model Water Quality Management Plan (Model WQMP)*, Exhibit 7.II, and *Technical Guidance Document* (TGD) *for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs)*, Exhibit 7.III.

Section 1 Project Description

1.	**Detailed development description:** The project, Tentative Tract 17423, is a proposed 3.71 acre single family residential development consisting of 33 residential lots, 7 open space lots, and a private street. Improvements include drainage facilities, utilities, and on-site street improvements. Site topography is relatively flat (1% or less). The site is bounded on the west and south by Harbor Blvd and Merrimac Way, respectively. The site is bounded on the east by an apartment complex and on the north by a commercial lot and an apartment complex.
2.	**Project location and site address:** The project is located at the southwest corner of the intersection of Harbor Blvd and Merrimac Way in the city of Costa Mesa, California. Assessors Parcel Numbers are 141-731-02, -03, 141-361-29, and -30. The project address is 2626 Harbor Blvd, Costa Mesa, CA.
3.	**Property size:** The project is approximately 3.71 acres.
4.	**Existing use:** The existing site is a local car sales business (zoning type C-1) and off-street parking (zoning type P).
5.	**Type of development:** The project is a residential development project, which is identified as a priority development project category in the new stormwater permits for the Santa Ana Regional Water Quality Control Board (RWQCB) of Orange County (R8-2009-0030).
7.	**Property ownership:** As a planned community, residential lots will be individually owned and common areas (private driveways/streets, common landscaped areas, designated parking areas, etc.) shall be owned by a Home Owners Association.
8.	**Zoning and land use designation:** Existing Zone: C-1 and P Proposed Zone: Residential Single Family Planned Development (RS-PD) Existing Land Use: Commercial Proposed Land Use: Medium Density Residential
9.	**Other:**

Section 2 Project Location Map

The location of the project site is illustrated in Figures 1 and 2.

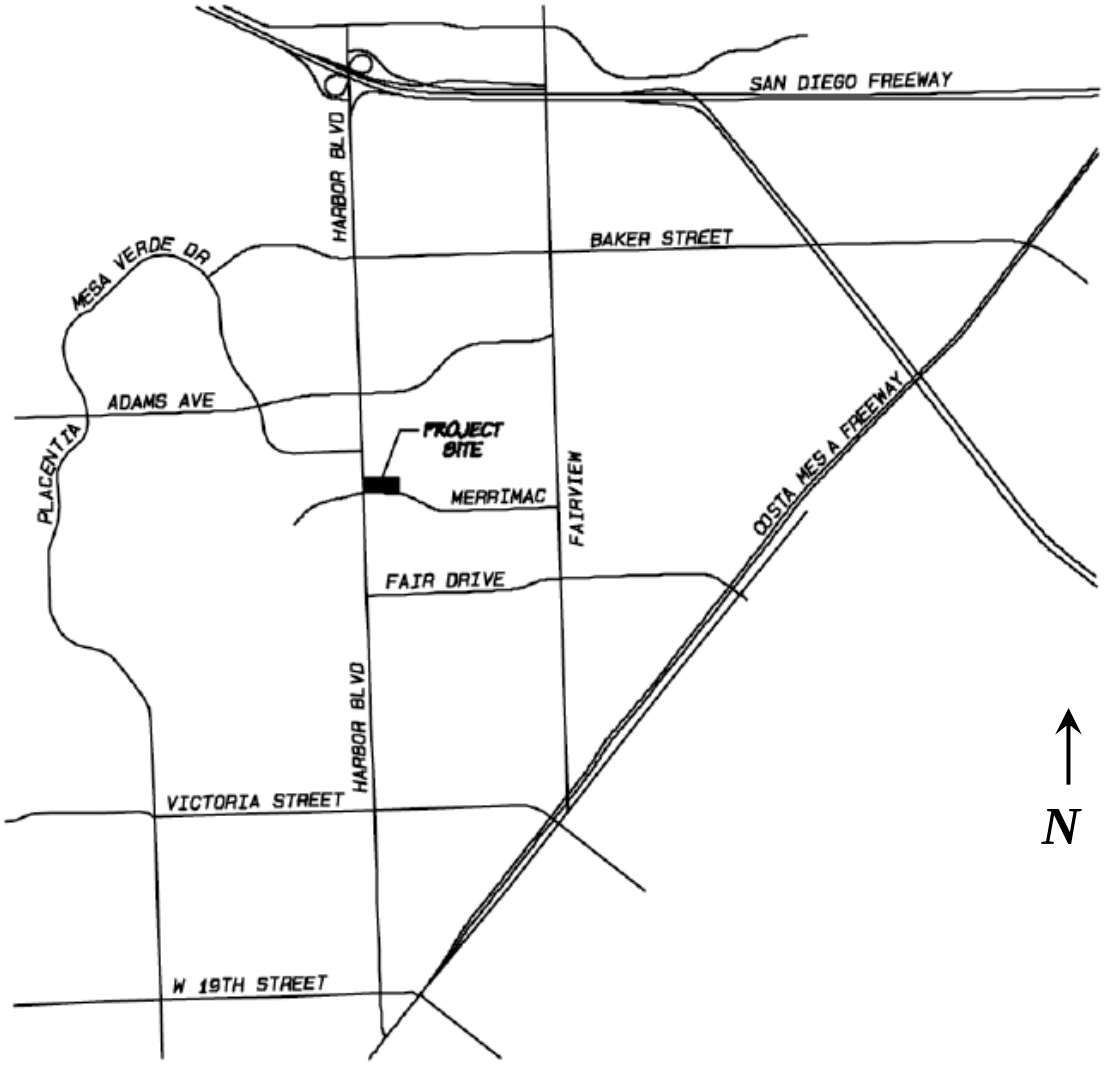
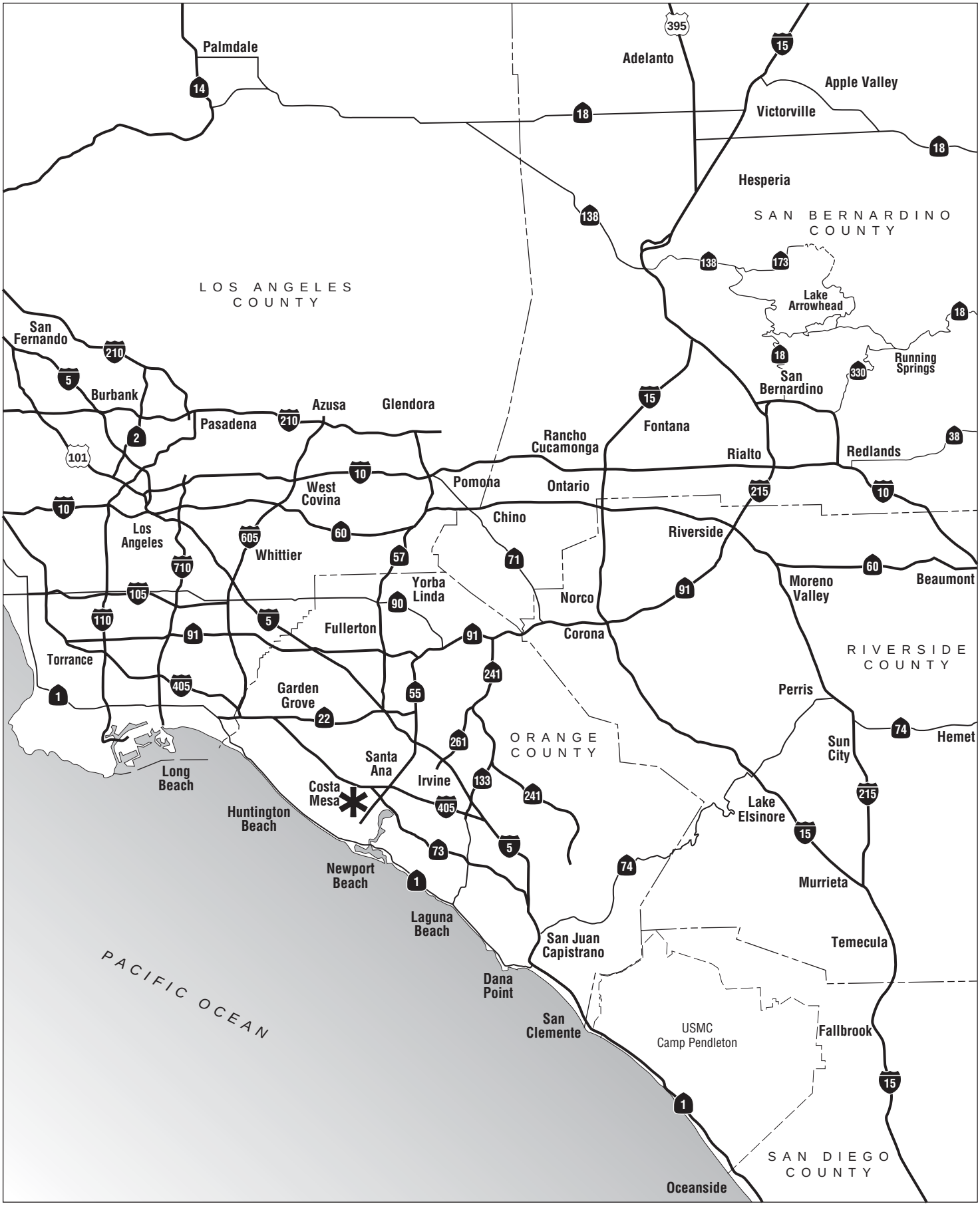


Figure 1 – Project Location Map
Thomas Brothers: Page 858, Grid J7
Not to Scale



RBF CONSULTING

0 5 11 miles
APPROXIMATE

6/08/11 JN 10-108150

2626 HARBOR BOULEVARD
INITIAL STUDY/MITIGATED NEGATIVE DECLARATION

Regional Vicinity

Figure **2**

Figure 3 – Site Aerial (Google, 2011) Photograph

Section 3 Project Site Assessment and Constraints

This project site assessment and constraints section provides important information that is used when considering the potential water quality and hydrologic impacts that could be caused by the proposed project. This information is important when considering the appropriate BMPs to reduce identified potential impacts as well as when developing measures to reduce those impacts.

1. Project location and boundaries: The project is located at the southwest corner of the intersection of Harbor Blvd and Merrimac Way in the city of Costa Mesa, California. (Lat/Long: 33.66880, -117.91801). The site is within the Newport Bay Watershed within the Central County Watershed Management Area (OC Watershed F).

2. Topography, soil and vegetation: The site consists of relatively flat topography at an elevation approximately 70 feet above mean sea level. The soil type beneath the commercial lot is predominately hydrologic soil type D. Due to the existing commercial and parking lot land use, the site is entirely impervious except for the narrow strips of grass landscaping along Harbor Blvd and Merrimac Way.

3. Impervious/pervious surface areas: The existing site is car sales and parking lot, thus nearly entirely impervious. The proposed developed surface area would be approximately 60% impervious.
Total Site Area A_{Total} = 3.7 Acres
Impervious Area, A_{Imp} = 2.2 Acres
Pervious Area, A_P = 1.5 Acres

4. Locations of drainage from off-site: The site does not capture any additional off-site drainage in either the existing or proposed conditions.

5 Proposed pools, parks, open spaces, tot lots and any maintenance issues related to them: The seven proposed open spaces will be maintained by the Homeowner's Association (HOA). There are no proposed community pools.

6. Existing drainage and underground infrastructure: Existing site drainage is split between two areas: westerly one-third of the site drains to Harbor Blvd; the reminder of the site drains to Merrimac Way. There is no existing underground infrastructure. However, underground infrastructures are included as part of the project.

7. Environmentally Sensitive Areas (ESAs) and/or Areas of Special Biological Significance (ASBS):

Area Name	303(d)	RARE	ASBS
Paularino Channel F03			
Santa Ana-Delhi Channel F01			
Newport Bay, Upper	X	X	
Newport Bay, Lower	X	X	
Pacific Ocean, Outlet			

303(d) – Water bodies required to be identified as not meeting water quality standards established for them, per Federal Clean water Act Section 303(d).
NCCP – Areas designated as preserves or their equivalent under the Natural Communities Conservation Program within the Cities and County of Orange (Coastal 3).
RARE – Water bodies designated with the RARE beneficial use by the State Water Resources Control Board. Rare, Threatened or Endangered Species (RARE) waters support the habitats necessary for the survival and successful maintenance of plant or

	animal species designated under state of federal law as rare, threatened or endangered. **Areas of Special Biological Significance (ASBS)** – A state water quality protection area (SWQPA) where point source waste and thermal discharges shall be prohibited or limited by special conditions. Nonpoint source pollution shall be controlled to the extent practicable.
8.	**Conditions/uses of adjacent parcels:** The site is bounded on the west and south by Harbor Blvd and Merrimac Way, respectively. The site is bounded on the east by an apartment complex and on the north by a commercial lot and an apartment complex.
9.	**Soil type(s) and geologic information:** The underlying soil onsite is predominantly Soil Group D according to the Natural Resources Conservation Service (NRCS) Web Soil Survey and Orange County Hydrologic Soil Map. The soil consists of 83% Cropley Clay and 17% Myford Sandy Loam according the Natural Resources Conservation Service Web Soil Survey.
10.	**Geotechnical considerations:** A geotechnical report will be prepared for this project at a later phase and will be submitted as required by the City.
11.	**Feasibility of infiltration, evapotranspiration, or harvest and use:** Infiltration is not feasible given the preliminary soil condition being predominately clay (or soil type D). Evapotranspiration is not feasible due to undetermined maintenance in the given climate and excessive cost. Harvest and use is feasible but not effective because sufficient demand for harvested rainwater is not present. Only seven common open space areas (approximately 0.27 acres) are present and scatter across the 3.7 acre site. There will be little to no landscape irrigation demand exists after an 85th percentile storm event.
12.	**Watershed and receiving waters:** The site drains to Watershed F San Diego Creek and Watershed G Newport Bay. The receiving waters downstream of the site are the following: Paularino Channel F03; Santa Ana-Delhi Channel F01; Newport Bay, Lower; Pacific Ocean, Outlet.
13.	**303(d) listed receiving waters:** Newport Bay, Lower is a 303(d) Listed Water Body. This site does not directly discharge to nor is the discharge point within 200 feet of a 303(d) Water Body.

Section 4 Pollutants of Concern

This section of the water quality management plan identifies primary and secondary pollutants of concern. Pollutants of concern are those that are anticipated to be generated by the proposed project. Pollutants of concern are differentiated between primary and secondary depending on the condition of downstream receiving waters. If the project will drain to a receiving water that is impaired for a pollutant anticipated from that project, that pollutant is a primary pollutant of concern. Pollutants frequently identified on the 303(d) list of California impaired water bodies include metals, nitrogen, nutrients, indicator bacteria, pesticides and trash (see 303(d) List). In some cases, there may be specific conditions (i.e. other known water quality problems) that warrant identifying an anticipated pollutant as a primary pollutant of concern. If there is no corresponding impairment or other water quality problem in the receiving waters for an anticipated pollutant, the pollutant is a secondary pollutant of concern.

Table 4.1 Potential Pollutants for Project Categories

1. Project land use categories: Anticipated and potential pollutants generated by detached residential developments include sediments, nutrients, pathogen (bacteria/virus), pesticides, oil & grease, and trash & debris (Reference: Table 7.II.1 of OC Model WQMP; see Appendix A).

2. Total Maximum Daily Loads (TMDLs) for receiving waters: The TMDLs that have been established for Newport Bay, Upper are: Metals, Nutrients, Pathogens, Pesticides, and Sediments. The TMDLs that have been established for Newport Bay, Lower are: Metals, Nutrients, Pathogens, and Pesticides

3. Project watershed information: Pollutants identified in the 303(d) list for impaired water bodies are as follows:

Water Body	2006 List	2010 List
Newport Bay, Upper	Metals, Nutrients, Pesticides, Toxicity, Turbidity, Other Organics	Metals, Nutrients, Pesticides, Toxicity, Turbidity, Other Organics
Newport Bay, Lower	Metals, Nutrients, Pesticides, Toxicity, Other Organics	Nutrients, Pesticides, Toxicity, Other Organics

4. Primary pollutants of concern:
Newport Bay, Upper: Nutrients, Pathogens (bacteria/virus), Pesticides, and Sediments
Newport Bay, Lower: Nutrients, Pathogens (bacteria/virus), and Pesticides

5. Secondary pollutants of concern: Trash & debris, oxygen demanding substances, and oil & grease.

Section 5 Hydrologic & Geotechnical Conditions of Concern

This section of the water quality management plan identifies hydrologic and geotechnical conditions of concern related to the proposed project. Hydrologic or geotechnical conditions of concern are identified through a review of on-site and downstream drainage paths. If the proposed project would cause or contribute flows to problems along on-site or downstream drainage paths, these problems or future problems are considered conditions of concern. Conditions of concern can include problems such as flooding, erosion, scour, and other impacts that can adversely affect channel and habitat integrity.

In order to identify conditions of concern, a comprehensive understanding of flow volume, rate, duration, energy, and peak flow is necessary. Often, a formal drainage study is necessary which considers the project area's location in the larger watershed, topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors. As part of the study, the drainage report includes:

- Field reconnaissance to observe downstream conditions
- Computed rainfall and runoff characteristics including a minimum of peak flow rate, flow velocity, runoff volume, time of concentration and retention volume
- Establishment of site design, source control and treatment control measures to be incorporated and maintained to address downstream conditions of concern

A hydrology study was prepared for the proposed project by RBF Consulting, as required by the City, and is included as Appendix B. A summary of the drainage report is provided in the table below.

A geotechnical report will be prepared for this project at a later phase and will be submitted as required.

1.	**MS4 permit:** The project site shall satisfy the requirements of Santa Ana (Region 8) Regional Water Quality Control Board (RWQCB) Order No. R8-2009-0030.
2.	**Watershed Master Plan (WMP):** San Diego Creek (Watershed F) and Newport Bay (Watershed G) have a Watershed Master Plan.
3.	**Project watershed information:** The San Diego Creek Watershed is approximately 86,822 acres. It includes the cities of Costa Mesa, Irvine, Laguna Hills, Laguna Beach, Costa Mesa, Newport Beach, Orange, Santa Ana and Tustin, as well as unincorporated portions of Orange County. The Newport Bay Watershed is approximately 10,025 acres. It includes the cities of Costa Mesa, Newport Beach, and unincorporated portions of Orange County.
4.	**Susceptibility to Hydrologic Conditions of Concern (HCOCs):** Per the North Orange County Permit, this project does not have the potential to have an HCOC because 1)the site imperviousness has been decreased from 90% to 60%; 2)all downstream channels (Paularino Channel F03 and Santa Ana-Delhi Channel F01) are engineered, hardened and regularly maintained.

5. Relevant hydrologic and environmental factors: The site is adjacent to developed land (residential and commercial area). The project site does not receive runoff from the adjacent parcels.

6. Proposed hydrologic conditions: The developed site will have a decrease in runoff due to a decrease in impervious area. The existing condition is approximately 90 percent impervious compared to approximately 60 percent impervious in the proposed condition. Runoff in the existing condition is mainly in the form of sheet flow across variable flat and shallow grades, whereas runoff in the proposed condition will be curb flow and conveyed with an underground storm drain system.

7. Significant impact on downstream channels and habitat integrity: Due to the proposed BMP and a decrease in site imperviousness, the proposed project is not anticipated to have significant impacts to downstream receiving water bodies.

8. Applicable design capture storm depth:
Design capture storm depth is 0.76".
(Reference: Appendix A. Figure 6.2 of Technical Guidance Document)

9. Categorize magnitude of HCOCs for project planning: Hydrologic conditions of concern do not exist for this project.

10. Identify the hierarchy of BMPs that shall be used: Retain on-site 80% of average annual stormwater runoff, OR

a. Retain stormwater runoff on-site (infiltrate, harvest and use, or evapotranspiration)
b. Recover storage volume as soon as possible after a storm event (drawdown)
c. Biotreat the remaining runoff volume on-site to achieve 80% average annual capture efficiency
d. Retain or biotreat remaining runoff volume in a regional facility to achieve 80% average annual capture efficiency
e. Fulfill alternative compliance obligations

11. Project hydrology analysis:
2-year storm analysis summary

	$Q_{2\text{-yr}}$ (cfs)	$V_{2\text{-yr}}$ (ac-ft)	$T_{c,2\text{-yr}}$ (min)
Predevelopment	4.82	0.45	11.72
Postdevelopment	4.34	0.27	12.53
% Difference	-10.0%	-40.0%	6.9%

The hydrology analysis parameter for the 2-year storm and additional hydrology analysis for the 10-, 25-, and 100-year storms can be found in the attached hydrology report prepared by RBF Consulting (June 13, 2011).

5.1 Identify Whether HCOCs Exist

HCOCs for North County

Per the Santa Ana RWQCB's Order No. R8-2009-0030, HCOCs are considered to exist if streams are determined to be potentially susceptible to hydromodification impacts and either of the following conditions exist:

	Condition	Yes	No	Calculations
1	Post-development runoff volume for the 2-yr, 24-hr storm exceeds that of the pre-development condition by more than 5 percent.		X	$V_{2\text{-yr,pre-development}}$ = 0.45 ac-ft $V_{2\text{-yr,post-development}}$ = 0.27 ac-ft Change = -40% < +5% Condition does not exist
2	Time of concentration of post-development runoff for the 2-year, 24-hour storm event is less than the time of concentration of the pre-development by more than 5 percent.		X	$T_{c,2\text{-yr,pre-development}}$ = 11.7 min $T_{c,2\text{-yr,post-development}}$ = 12.5 min Change = 6.9% > 5% Condition does not exist

Per the above calculations, hydrologic conditions of concern do not exist for this project.

Section 6 Best Management Practices (BMPs)

Minimizing a development's effects on water quality and the environment can be most effectively achieved by using a combination of Site Design Principles, Low Impact Development (LID) BMPs, Source Control BMPs and Treatment control BMPs. The strategy consists of: 1) reducing or eliminating post-project runoff; 2) controlling sources of pollutants; and 3) treating stormwater runoff before discharging it to the storm drain system or to receiving waters.

This WQMP and the proposed BMPs for the proposed project have been developed to minimize drainage impacts identified in Section 5 and the introduction of pollutants identified in Section 4 into the municipal storm drain system and/or ultimate drainage receiving water body.

For more detailed information on the use and design of BMPs please see the California Stormwater Quality Association New development and Redevelopment handbook. The handbook is available at www.cabmphandbooks.com. Additional information is also available in the City's LIP.

6.1 Site Design Principles and Techniques

LID site design practices can be implemented to reduce the volume of stormwater runoff generated on a project site as well as improve the quality of runoff that leaves the site. These are considered "preventative" aspects of LID, and, if implemented in the site design at the earliest phases of the project planning process, can result in smaller LID, source control, treatment control, and/or hydromodification control BMPs.

6.1.1 Maximize natural infiltration capacity

1.	**Take advantage of Hydrologic Soil Group A or B and in some cases Group C:** The underlying soil onsite is over 80% Soil Group D according to NRCS Web Soil Survey. The site design incorporates various LID BMPs to the maximum extent possible.
2.	**Use mild slopes or depressions:** The project site is located on a mild slope location. The proposed street slope at 0.4%. LID BMPs are strategically located at low drainage points. Open space and residential yards will use mild slopes.
3.	**Minimize unnecessary compaction:** The site shall minimize unnecessary compaction except for the areas recommended by the geotechnical report.
4.	**Minimize construction footprint:** Although construction will occur across the entire site for rough grading and soil stability purposes, LID BMPs will be incorporated to the maximum extent possible.
5.	**Use permeable paving materials:** Per the NRCS Web Soil Survey's preliminary soil group being mostly clay, infiltration type BMP such as permeable paving material is not feasible.

6.1.2 Preserve existing drainage patterns and time of concentration

1.	**Avoid channelization of natural streams:** No natural streams exist on the site in either the pre-developed or post-developed conditions.
2.	**Use mild slopes and increase channel roughness to extend time of concentration:** No channels exist on the site. Runoff shall be conveyed through a storm drain system with a longer travel path in the proposed condition than in the pre-developed condition, thereby extending the time of concentration.
3.	**Use pervious channel linings to maximize opportunity for infiltration:** No channels exist on the site in either the pre-developed or post-developed conditions.
4.	**Use vegetated, un-hardened conveyance elements:** Vegetated, un-hardened conveyance elements are proposed on each residential unit.
5.	**Intersperse localized retention features throughout site:** Each of the proposed residential units has disconnected impervious areas that promote localized bioretention.

6.1.3 Protect existing vegetation and sensitive areas

1.	**Establish set-backs and buffer zones surrounding sensitive areas:** The proposed development is on an existing car sales lot and surrounded by commercial and residential properties, thus no sensitive areas exists.
2.	**Incorporate established trees into site layout:** No established trees already exist on the pre-developed site. However, trees shall be planted in the proposed development.
3.	**Use native or drought tolerant trees and shrubs:** Climate- and location-appropriate trees shall be planted per landscape architect recommendations. This project shall use drought tolerant vegetation and/or trees where possible.
4.	**Incorporate landscaped buffers:** Open space lots approximately 2,580 ft^2 in size shall provide a buffer between the development. Proposed landscape strips will act as a set-back from the street sidewalk.
5.	**Conservation of natural areas:** The proposed development is on an existing car sales (90% impervious), thus conservation of natural area does not apply.

6.1.4 Minimize Impervious Area

1.	**Minimize building footprint:** The homes shall be up to 2-stories in height, minimizing the horizontal building footprint. In addition, the project layout has created a significant landscape area around the perimeter of each residence. There are frontage yards and side yards, and most of the project perimeter is landscaped.
2.	**Reduce road widths:** The road widths for all residential streets within the project are designed to the City of Costa Mesa standard for local streets.
3.	**Minimize lot setbacks and driveway lengths:** Lot setbacks have been minimized to provide minimal driveway lengths while still satisfying maximum grade requirements for driveways.

4.	**Minimize impervious area of sidewalks, driveways and parking areas:** The sidewalk width shall be minimized, but still satisfies requirements per the Americans with Disabilities Act. Resident driveways parking areas shall be minimized where possible.

6.1.5 Disconnect impervious areas

1.	**Provide permeable areas within medians and parkways that are designed to accept runoff from adjacent areas:** The site has no medians or parkways. However, the lack of parkways allows for more room for continuous front yard landscaping for each residence.
2.	**Construct roof downspouts to drain to pervious areas:** Roof drain downspouts are to be drained to pervious areas around the residential lots. Splash pads are to be incorporated to prevent erosion.
3.	**Use vegetated drainage swales:** Vegetated drainage swales will be used where possible.
4.	**Incorporate permeable areas into site drainage system:** All roof runoff will be drained to pervious landscaped areas around the residential lots, and conveyed through pervious vegetated swales to the driveways.
5.	**Use permeable paving materials on driveways, parking areas and sidewalks:** The site design does not have sidewalks or street parking, thus reducing the roadway system impervious area. Permeable paving materials shall be used on driveways where possible.

6.1.6 Minimize construction footprint

1.	**Minimize the amount of site clearing and grading:** The existing site is a car sales lot (90% impervious), thus nearly all of the site area will have to disturbed. However, the proposed development will significantly reduce the imperviousness as a result.
2.	**Minimize soil compaction from heavy construction equipment:** Soil shall be compacted per the geotechnical report recommendations.
3.	**Clearly define protection areas:** The undisturbed area, if any, shall be clearly defined on site plans.

6.1.7 Revegetate disturbed areas

1.	**Maximize canopy interception to reduce erosive potential of precipitation:** The project perimeter and residential street perimeters shall have grass, shrubs, and/or trees planted per the landscape architect's design to provide a canopy for interception of precipitation.
2.	**Establish a healthy plant and soil community to assist with pollutant remediation:** Landscape architect plans will identify a concept plant schedule for the proposed landscape and open space areas. Maximized pervious area throughout the project shall provide biofiltration opportunities.
3.	**Establish a thick vegetative cover to maintain soil infiltration rates:** Vegetation cover will be provided at the landscaping areas and open space lots, but little infiltration are expected given the soil type from NRCS Web Soil Survey. Trees and landscaping at each residence shall also provide vegetative cover.

6.2 Low Impact Development BMPs

Low Impact Development (LID) performance criteria prioritize the use of BMPs as follows: Hydrologic Source Controls (HSC), Infiltration, Harvest and Use, Evapotranspiration, and Biotreatment. Feasibility Screening is performed to determine which of these BMPs are suitable for consideration in developing an integrated stormwater design. This section describes the Feasibility Screening process and summarizes which BMPs are determined feasible for the given project site.

6.2.1 Level 1 Feasibility Screening Process

Below is a table summarizing BMP selection and prioritization as a result of the Level 1 Feasibility Screening Process. The reference for the Level 1 Feasibility Screening Process is the hydrologic source control fact sheets in the Technical Guidance Document and the California Stormwater BMP Handbook.

Infiltration on the site is not feasible due to the soil type. However, the San Diego watershed Hydromodification Management Plan states the following: “Even if infiltration is shown to be infeasible, LID facilities can be designed as filtration-type or evaporation-type facilities instead of infiltration-based facilities.” This concept has been applied to some of the LID BMPs described below.

Table 6.1 Level 1 Feasibility Screening Process				
Assessment	Level 1 Feasibility Screening Results	Opportunity for drainage area	Priority Level	Implement?
Key to Ranking	/ Shall O May X Shall Not	X = No Opportunity H, M, L = Level of Suitability	/ + H = Priority 1 / + M = Priority 2 / + L = Priority 3 O + H,M,L = Priority 3	Yes / No
Hydrologic Source Controls				
Localized on-lot infiltration	O	M	3	No
Impervious area dispersion	O	M	3	Yes
Street trees / Canopy cover	O	H	3	Yes
Residential rain barrels not actively managed	O	L	3	No
Infiltration BMPs				
Bioretention without Underdrains / Rain	O	L	3	No
Infiltration Basin	O	L	3	No
Infiltration Trench / French Drain	O	L	3	No
Dry Well	O	L	3	No
Underground Infiltration	O	L	3	No
Permeable Pavement	O	L	3	No
Harvest and Use BMPs				
Harvest and Use for Landscape Demand	X	X	3	No
Harvest and Use for Indoor Demand	X	X	3	No
Harvest and Use for Mixed Demand	X	X	3	No
Harvest and Use for Other Demand	X	X	3	No
Biotreatment BMPs				
Bioretention with Underdrains	/	M	2	No
Vegetated Swales	/	M	2	No
Vegetated Filter Strips	/	M	2	No
Constructed Wetlands	/	L	3	No
Proprietary Biotreatment	/	H	1	Yes

6.2.2 Hydrologic Source Controls

1.	**Localized on-lot infiltration:** The soil type is not uniformly conducive to infiltration and will likely not achieve the required infiltration rate.
2.	**Impervious area dispersion:** Roof downspout dispersion techniques shall be implemented for each residence where feasible. Although the soil type is not uniformly conducive to infiltration, dispersing the roof runoff onto adjacent landscaping areas will provide other benefits: lengthen the runoff travel time and control the peak flow; provide evapotranspiration during the lengthened travel; and provide some natural infiltration, storage and pollutant removal due to the inherent properties of grass and landscaping. Splash pads are to be incorporated to prevent erosion of landscaped areas.
3.	**Street trees / canopy cover:** Street trees shall be incorporated into the site design along the residential streets and the perimeter of the project site. Street tree canopy interception will provide the following benefits: lengthen the runoff travel time and control the peak flow and provide evapotranspiration.
4.	**Residential rain barrels (not actively managed):** The project site does not provide sufficient vegetated areas to require stored water to be used for irrigation. No landscape irrigation demand exists for periods of longer than 1 week following an 85th percentile, 24-hour storm event. Furthermore, allowing roof downspouts to disperse onto a pervious area will provide better runoff and pollutant control given the site conditions and layout.

6.2.3 Infiltration BMPs

5.	**Bioretention without underdrains / rain:** The soil type is not uniformly conducive to infiltration and will likely not achieve the required infiltration rate.
6.	**Infiltration basin:** The soil type is not uniformly conducive to infiltration and will likely not achieve the required infiltration rate. The majority of the site will not be on native soil, making an infiltration basin infeasible.
7.	**Infiltration trench / French drain:** The soil type is not uniformly conducive to infiltration and will likely not achieve the required infiltration rate. The majority of the site will not be on native soil, making infiltration trenches infeasible.
8.	**Dry well:** The soil type is not uniformly conducive to infiltration and will likely not achieve the required infiltration rate. The majority of the site will not be on native soil, making dry wells infeasible.
9.	**Underground infiltration:** The soil type is not uniformly conducive to infiltration. The majority of the site will not be on native soil, making underground infiltration infeasible.
10.	**Permeable pavement:** The soil type is not uniformly conducive to infiltration, thus making the permeable pavement infeasible.

6.2.4 Harvest and Use BMPs

11.	**Harvest and use for landscape demand:** No landscape irrigation demand exists for periods of longer than 1 week following an 85th percentile, 24-hour storm event, and the project is single family residential land use with density 9 dwelling units per acre. Due to insufficient demand, harvest and use systems are not beneficial.

12.	**Harvest and use for indoor demand:** The site is not designated for reclaimed water use for irrigation and/or toilet flushing. Insufficient indoor use demand is available for harvested stormwater use.
13.	**Harvest and use for mixed demand:** Due to the reasons mentioned above, harvest and use systems are not beneficial for the project site.
14.	**Harvest and use for other demand:** Due to the reasons mentioned above, harvest and use systems are not beneficial for the project site.

6.2.5 Biotreatment BMPs

15.	**Bioretention with underdrains:** Proprietary bioretention planter boxes with underdrains are incorporated into the site design.
16.	**Vegetated swales:** Vegetated swales shall be considered for each residence for rooftop runoff dispersion for pollutant removal and flow velocity reduction. However, they may not be designed to the recommended length, width and infiltration capabilities due to lot size and soil restrictions mentioned above.
17.	**Vegetated filter strips:** Not enough pervious sheet flow condition along the proposed street for this BMP to be considered. Vegetated strips shall be considered for each residence for rooftop runoff dispersion for pollutant removal and flow velocity reduction.
18.	**Constructed wetlands:** Due to lack of perennial water source to maintain the permanent pool, constructed wetland is not feasible.
19.	**Proprietary biotreatment:** Proprietary bioretention planter boxes with underdrains are incorporated into the site design. This BMP provides water quality treatment by means of pollutant and sediment removal, a filter media for bacteria removal, and the roots for the nutrient removal.

6.3 Source Control BMPs

Source Control BMPs are measures focusing on reducing or eliminating post-project runoff and controlling sources of pollutants. Source Control BMPs must be included in all projects and can be represented in structural measures such as landscape, irrigation, signage considerations, materials, and design of areas; and non-structure measures such as requirements, cleaning, education, and maintenance.

Table 6.2 Source Control Non-Structural BMPs

Number	BMP and Objective	Included
Routine Non-Structural BMPs		
N1	**Education for Property Owners, Tenants and Occupants:** Practical informational materials are provided to residents, occupants, or tenants to increase the public's understanding of stormwater quality, sources of pollutants, and what they can do to reduce pollutants in stormwater. *Explanation/Description:* Educational materials for residents are an important part of improving storm water quality. Orange County's Watershed Program provides educational material for residents (see Appendix C). Further information and stormwater quality brochures can be found at: http://www.ocwatersheds.com/PublicEd/	Y
N2	**Activity Restrictions:** Rules or guidelines for developments are established within appropriate documents (i.e. CC&Rs, lease terms, etc.) which prohibit activities that can result in discharges of pollutants. *Explanation/Description:* CC&Rs are to be determined prior to final submittal.	Y
N3	**Common Area Landscape Management:** Specific practices are followed and ongoing maintenance is conducted to minimize erosion and over-irrigation, conserve water, and reduce pesticide and fertilizer applications. *Explanation/Description:* The Homeowners' Association (HOA) will be responsible for maintenance of the common landscaped areas onsite.	Y
N4	**BMP Maintenance:** In order to ensure adequate and comprehensive BMP implementation, all responsible parties are identified for implementing all non-structural BMPs and for structural BMPs, cleaning, inspection, and other maintenance activities are specified including responsible parties for conducting such activities. *Explanation/Description:* The HOA will be responsible for onsite BMP maintenance per Operations and Maintenance Plan (see Section 8.1).	Y
N5	**Title 22 CCR Compliance:** Hazardous waste is managed properly through compliance with applicable Title 22 regulations. *Explanation/Description:* N/A. Title 22 does not apply, as this is not a community care facility.	N
N6	**Local Water Quality Permit Compliance:** The project complies with water quality permits issued by the City to ensure clean stormwater discharges. *Explanation/Description:* The project will comply with all water quality permits issued by the city, County, State, etc.	Y

N7	**Spill Contingency Plan:** A Spill Contingency Plan is implemented to ensure that spills are managed properly by requiring stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc. *Explanation/Description:* Not applicable because this is a residential development.	N
N8	**Underground Storage Tank Compliance:** Because of the known or potential presence of underground storage tanks (USTs) on the project site, applicable UST regulations apply and are adhered to in order to avoid harm to humans or the environment. *Explanation/Description:* No USTs exist onsite.	N
N9	**Hazardous Materials Disclosure Compliance:** Because hazardous materials or wastes will be generated, handled, transported, or disposed of in association with the project, measures are taken to comply with applicable local, state, and federal regulation to avoid harm to humans and the environment. *Explanation/Description:* Not applicable because this is a residential development.	N
N10	**Uniform Fire Code Implementation:** The project includes a hazardous material storage facility or other area regulated by Article 80 and therefore implements measures to comply with this section of the Uniform Fire Code. *Explanation/Description:* Hazardous material storage facility or other similar facility, regulated by Article 80, not included in site design.	N
N11	**Common Area Litter Control:** Trash management and litter control procedures are specified, including responsible parties, and implemented to reduce pollution of drainage water. *Explanation/Description:* The HOA is responsible for all Common Area maintenance.	Y
N12	**Employee Training:** Practical informational materials and/or training are provided to employees to increase their understanding of stormwater quality, sources of pollutants, and their responsibility for reducing pollutants in stormwater. *Explanation/Description:* Not applicable because this is a residential development.	N
N13	**Housekeeping of Loading Docks:** Cleaning and clean up procedures are specified and implemented for loading dock areas to keep the area free for pollutants and reduce associated pollutant discharges. *Explanation/Description:* Loading docks are not incorporate in the site design.	N
N14	**Drainage Facility Inspection:** Inspection procedures, schedules, and responsibilities are established for drainage facilities to ensure regular cleaning, inspection, and maintenance. *Explanation/Description:* The HOA is responsible for all Drainage Facility Inspection and Maintenance. Inspection and Maintenance procedures are outlined in the Operation and Maintenance Plan found in Section 8.1.	Y
N15	**Street Sweeping Private Streets and Parking Lots:** Street sweeping frequency and responsible parties are identified and regular sweeping is conducted to reduce pollution of drainage water. *Explanation/Description:* Street sweeping frequency and responsible parties are identified and regular sweeping is conducted to reduce pollution of drainage water.	Y

N17	**Retail Gasoline Outlets:** Specific operational and maintenance BMPs are implemented to the extent feasible to reduce potential for pollutant discharge from wash off by runoff, leaks, and spills. *Explanation/Description:* Gasoline outlets are not part of this project.	N

Table 6.3 Source Control Structural BMPs

Number	BMP and Objective	Included
Source Control Structural BMPs (numbers correspond to the California BMP Handbook)		
SD-10	**Site Design and Landscape Planning:** Landscape planning methodologies are incorporated into project design to maximize water storage and infiltration opportunities and minimize surface and groundwater contamination from stormwater. *Explanation/Description:* Landscaped areas have been maximized in the site layout to provide first contact infiltration and reduce impervious surfaces where practical.	Y
SD-11	**Roof Runoff Controls:** Direct roof runoff away from paved areas and to pervious areas, cisterns, infiltration trenches, and/or storage areas for reuse to reduce total volume and rate of site runoff and retain pollutant on site. *Explanation/Description:* Roof drain downspouts are to be directed to landscaped areas around residential lots. Splash pads shall be provided at downspout outlet to prevent erosion of landscaped areas.	Y
SD-12	**Efficient Irrigation:** Project plans include application methods to minimize irrigation water discharged into stormwater drainage systems. *Explanation/Description:* Landscaped common areas shall be irrigated efficiently to reduce dry weather runoff. Common area irrigation is to be maintained by the HOA. Residents are to be educated on efficient irrigation practices to minimize residential dry weather runoff.	Y
SD-13	**Storm Drain System Signs:** Stencils or affixed signs a placed adjacent to storm drain inlets to prevent waste dumping at storm drain inlets. *Explanation/Description:* All catch basins are to be equipped with “No Dumping – Drains to Ocean” stencils and/or placards.	Y
SD-20	**Pervious Pavements:** Porous concrete or asphalt, blocks with pervious spaces or joints, or grass or gravel surfaces are employed to reduce runoff volume and provides treatment. *Explanation/Description:* Permeable concrete pavers are to be incorporated at the “A” Street entrance and at the bulbs of the cul-de-sacs of “C” and “E” Streets where guest parking is provided.	Y
SD-21	**Alternative Building Materials:** Specialized building materials are employed that have lower potential to leach pollutants, and reduce need for future painting or other pollutant generating maintenance activities. For example, some treated wood contains pollutants that can leach out to the environment and some metal roofs and roofing materials result in high metal content in runoff. *Explanation/Description:* Water quality is to be considered when selecting building	Y

	materials and using equipment during construction operations.	
SD-30	**Fueling Areas:** Project plans are developed for cleaning, spill cleanup, containment, leak prevention, and incorporation of design to reduce rain and runoff that could come in contact with fueling areas. *Explanation/Description:* N/A. Fueling areas will not be incorporated in this residential development.	N
SD-31	**Maintenance Bays and Docks:** Project design incorporates measures to cover or otherwise eliminate run-on and off from bays and docks, and direct connections to storm drain are eliminated. *Explanation/Description:* N/A. Maintenance bay/docks will not be incorporated in this project.	N
SD-32	**Trash Enclosures:** Trash storage areas are covered and enclosed to prevent introduction of trash and debris to site runoff. *Explanation/Description:* Each residence will be equipped with individual containers for trash, recycling, and green waste.	N
SD-33	**Vehicle and Equipment Washing Areas:** Designated wash areas or facilities are contained and wash water is reused, treated, or otherwise properly disposed of. *Explanation/Description:* S.W.P.P.P. shall address Vehicle and Equipment Washing Areas for use during construction operations.	Y
SD-34	**Outdoor Material Storage Areas:** Outdoor storage areas for materials containing pollutants, especially hazardous materials, are covered and enclosed, on impervious surfaces, and include secondary containment when applicable. *Explanation/Description:* S.W.P.P.P. shall address Outdoor Material Storage Areas for use during construction operations.	Y
SD-35	**Outdoor Work Areas:** Outdoor work areas are covered, contained, and treated as necessary to reduce opportunity of pollutants from work activities to enter stormwater. *Explanation/Description:* N/A. Outdoor Work Areas will not be incorporated in this design.	N
SD-36	**Outdoor Processing Areas:** Outdoor processing areas are covered, contained, and treated as necessary to reduce opportunity of pollutants from work activities to enter stormwater. *Explanation/Description:* N/A. Outdoor Processing Areas will not be incorporated in this design.	N

6.4 Treatment Control BMPs

Per the Santa Ana RWQCB's Order No. R8-2009-030 NPDES No. CAS618030 for the City of Costa Mesa and Co-permittees, the water quality "…mitigative measures should be prioritized with the highest priority for BMPs that remove storm water pollutants and reduce runoff volume, such as infiltration, then other BMPs, such as harvesting and re-use, evapotranspiration and bio-treatment should be considered. These LID BMPs must be implemented at the project site in a manner consistent with the maximum extent practicable standard. Where LID BMPs are not feasible at the project site, more traditional, but equally effective control measures should be implemented." The permit requires "…that each priority development project infiltrate, harvest and re-use, evapotranspire, or bio-treat the 85th percentile storm event…" and states that "A properly engineered and maintained bio-treatment system may be considered only if infiltration, harvesting and reuse and evapotranspiration cannot be feasibly implemented at a project site."

Treatment control BMPs consist of public domain BMPs (identified in the following table with as TC-##) and manufactured or proprietary BMPs (identified in the following table with as MP-##). BMP numbers correspond to the California BMP Handbook.

The following table identifies the treatment control BMPs included in the proposed project.

Table 6.4 Treatment Control BMPs

Number	BMP and Objective	Included
	Infiltration	
TC-10	**Infiltration Trench:** A long narrow rock filled trench with no outlet receives water and stores it until it infiltrates into the underlying soil. Its effective are removing most pollutants but can get clogged with sediment. *Explanation/Description:* The soil type is not uniformly conducive to infiltration and will likely not achieve the required infiltration rate.	N
TC-11	**Infiltration Basin:** A shallow impoundment designed to capture and hold stormwater until it infiltrates into underlying soil. Effective at removing most pollutants but requires large areas and may be constrained by soil types. *Explanation/Description:* The soil type is not uniformly conducive to infiltration and will likely not achieve the required infiltration rate.	N
TC-12	**Retention/Irrigation:** Stormwater is captured in cistern, basin, trench, or other storage area and is subsequently used for irrigation of site landscaping. *Explanation/Description:* No landscape irrigation demand exists for periods of longer than 1 week following an 85th percentile, 24-hour storm event, and the project is single family residential land use. Due to insufficient demand, harvest and use systems are not beneficial.	N
	Detention and Settling	

TC-20	**Wet Pond:** A constructed basin with a permanent pool of water throughout the year. Differ from wetlands because it is of greater depth. Treats stormwater runoff by settling and biological uptake. *Explanation/Description:* Due to lack of perennial water source to maintain the permanent pool, wet pond is not feasible.	N
TC-21	**Constructed Wetland:** A constructed basin with permanent pool of shallow water throughout most of year with substantial vegetative coverage. *Explanation/Description:* Due to lack of perennial water source, constructed wetland is not feasible. Proprietary bioretention planter boxes already have been included in the site design that provides similar performance.	N
TC-22	**Extended Detention Basin:** A constructed basin with an outlet designed to detain stormwater for at least 48 hours to allow particles and pollutants to settle. *Explanation/Description:* This project has incorporated proprietary bioretention planter boxes in addition to increasing the site's time of concentration while reducing runoff volume in post project condition.	N
MP-20	**Wetland:** Similar to a constructed wetland but a self contained, manufactured module with vegetation that mimics natural wetland processes. *Explanation/Description:* Due to lack of perennial water source to maintain the permanent pool, wetland is not feasible.	N
	Biofiltration	
TC-30	**Vegetated Swale:** Open, shallow, vegetated channels that collect and slowly convey runoff through the property. Filters runoff through vegetation, subsoil matrix, and/or underlying soils; traps pollutants, promotes infiltration and reduce flow velocity. *Explanation/Description:* Vegetated swales shall be considered for each residence for rooftop runoff dispersion for pollutant removal and flow velocity reduction. A vegetated swale will provide other benefits: lengthen the runoff travel time and decrease runoff velocity; provide evapotranspiration during the lengthened travel; and provide some natural infiltration, storage and pollutant removal due to the inherent properties of grass and landscaping. However, the swales within each parcel may not be designed to the recommended length, width and infiltration capabilities due to lot size and soil restrictions mentioned above, nor are they necessarily expected to be implemented, to the expected recommendations, within the private parcel, which will not be regulated or maintained by the HOA.	Y
TC-31	**Vegetated Buffer Strip:** Vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Removes pollutants by deceleration, settling, and infiltration. *Explanation/Description:* Not enough pervious sheet flow condition along the proposed street for this BMP to be considered. Vegetated strips shall be considered for each residence for rooftop runoff dispersion for pollutant removal and flow velocity reduction. A vegetated buffer strip will provide the following benefits: lengthen the runoff travel time and decrease runoff velocity; provide evapotranspiration during the lengthened travel; and provide some natural infiltration, storage and pollutant removal due to the inherent properties of grass and landscaping. However, the buffer strips within each parcel may not be designed to the recommended length, width and infiltration capabilities due to lot size and soil restrictions mentioned above, nor are they necessarily expected to be implemented, to the expected recommendations, within the private parcel,	Y

	which will not be regulated or maintained by the HOA.	
TC-32	**Bioretention:** A soil and plant based filtration strategy that involved capturing stormwater in depressed landscaped areas. Bioretention practices are flexible strategies for using landscaping as treatment. *Explanation/Description:* Proprietary bioretention planter boxes have been selected to be incorporated into the site design given the primary pollutants of concern and the compact footprint in an urbanized environment.	Y
	Filtration	
TC-40	**Media Filter:** Usually two-chambered with a pretreatment settling basin and a filter bed filled with sand or other absorptive filter media. *Explanation/Description:* Proprietary bioretention planter boxes are already included in the site design.	N
MP-40	**Media Filter:** Similar to constructed media filter but manufactured as self-contained filtering vaults, units, or cartridges. *Explanation/Description:* Not included. See explanation for TC-40.	N
	Flow Through Separation	
TC-50	**Water Quality Inlet:** Vaults with chambers including screens, settling areas, and/or filter media to promote settling and/or separation of pollutants from stormwater. *Explanation/Description:* Proprietary bioretention planter boxes are already included in the site design.	N
MP-50	**Wet Vault:** A vault with a permanent water pool and internal features to promote settling and/or separation of pollutants from stormwater. *Explanation/Description:* Proprietary bioretention planter boxes are already included in the site design. A permanent pool may cause vector issues.	N
MP-51	**Vortex Separator:** Similar to wet vaults but round and use centrifugal action as primary separation mechanism. *Explanation/Description:* Not included. See explanation for TC-50.	N
MP-52	**Drain Inserts:** Boxes, trays, or socks with screens or filter fabric and may also include filter media. They are installed in inlets or catch basins and removal effectiveness for pollutants is generally low except for large sediment. *Note: Drain inserts cannot be the sole Treatment Control BMP selection for Priority Projects.* *Explanation/Description:* The proprietary bioretention planter boxes already included in the site design are much more effective treatment devices.	N
	Other	
TC-60	**Multiple Systems:** A system that uses two or more BMPs in series to increase treatment. Useful when one BMP does not provide sufficient treatment alone. *Explanation/Description:* The BMP train includes LID BMPs incorporated on-site (pervious area dispersion and tree canopy) to reduce the pollutants/runoff and proprietary bioretention planter boxes to treat the additional pollutants.	Y

6.4.1 Selected BMPs

The treatment control BMPs for this project primarily consist of proprietary bioretention planter boxes (to treat the remaining stormwater pollutants leaving from the individual residential units and street. These proprietary bioretention planter boxes will be sized to treat the 85th percentile design storm depth of 0.76" for Costa Mesa area (Reference: Appendix A. Figure 6.2 of Technical Guidance Document). All the urban runoff (per the design storm depth) from this 3.71 acre project site shall be treated prior to discharge into the local storm drain system.

The California Stormwater Quality Association (CASQA) has provided study results that show the estimated pollutant removal efficiencies for bioretention devices to be highly effective against the primary pollutants of concern:

Pollutant	Removal Rate %[a]
Total Phosphorus	98%
Metals (Cu, Zn, Pb)	22%
TKN	83%
Total Suspended Solids	81%
Organics	80%
Bacteria	84%

a. Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

6.4.2 Hydromodification Control BMPs

Hydromodification Control BMPs may be integrated with LID BMPs to meet the hydromodification performance criteria discussed in Section 5. The LID BMPs that will be integrated in order to satisfy hydromodification performance criteria include the following:

- Impervious area disconnect in the form of rooftop downspout dispersion
- Street tree canopy
- Increase pervious area compared to existing condition
- Bioretention planter boxes

6.4.3 Hydromodification Control Performance Criteria

Per the calculations in Section 5, hydrologic conditions of concern do not exist for this site.

6.4.4 Sizing of BMPs

The proprietary bioretention planter boxes (Katchall or Filterra equivalent) shall be sized by the manufacturers to capture and treat the flows or volumes of water that will be generated by the site's design capture storm. The water quality volume (based on the

85th percentile design storm depth of 0.76" for Costa Mesa area) for each proposed BMP location is summarized below:

BMP ID	Drainage Area (ac)	Runoff Coefficient	85th Percentile Design Storm (in)	Water Quality Volume (cf)
1	1.79	0.60	0.76	2963
2	0.75	0.60	0.76	1241
3	0.49	0.60	0.76	811
4	0.57	0.60	0.76	944

6.4.5 Location of BMPs

A minimum of four (up to six) proprietary bioretention planter boxes will be located on-site at the most downstream location of each sub-watershed area (just before runoff drains into the proposed streets storm water catch basins). The proposed storm drain layout and treatment BMP locations are shown in Section 7.

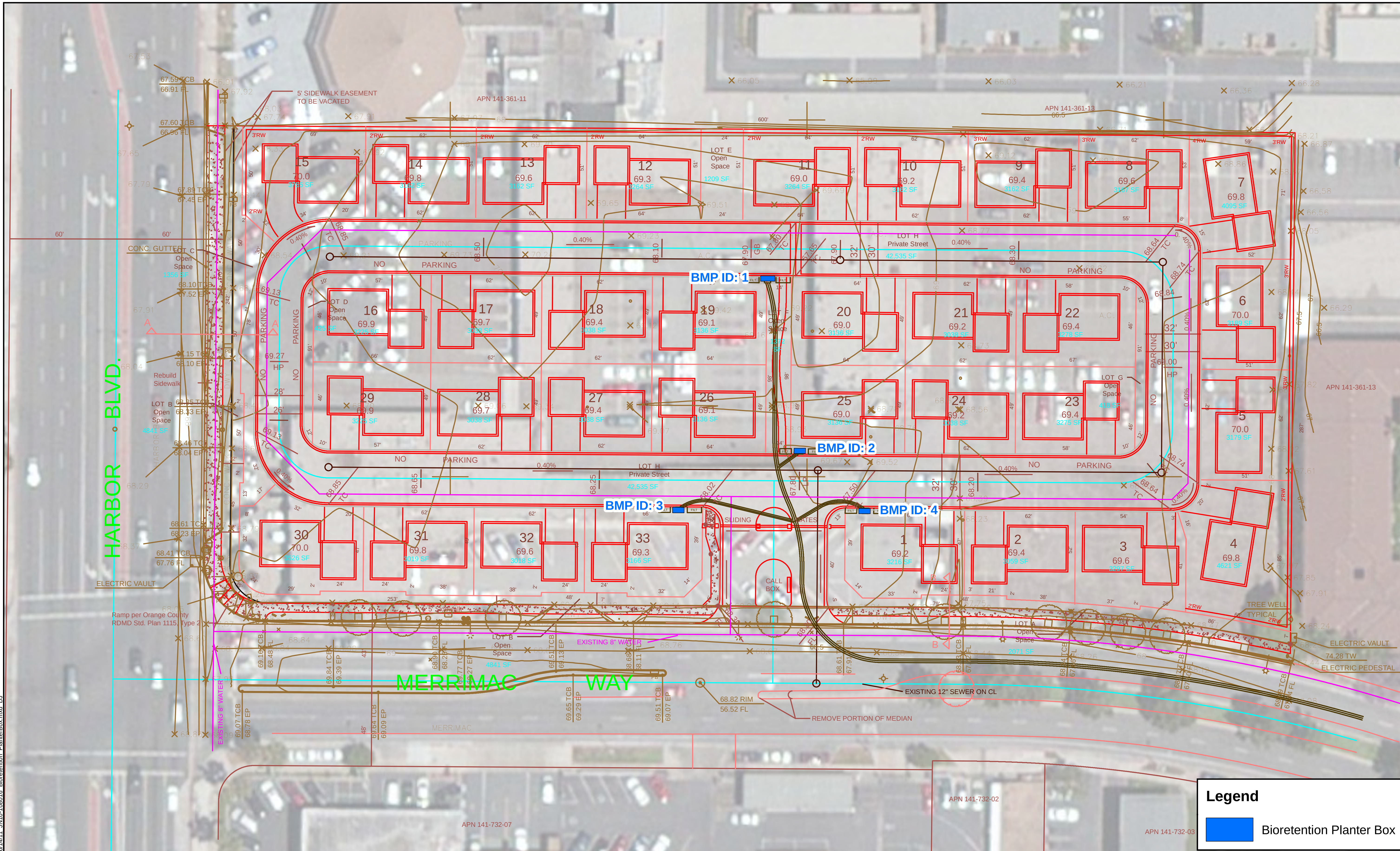
6.5 Restrictions on Use of Infiltration BMPs

The proposed project does not includes infiltration BMPs (BMPs that are designed to primarily function as infiltration devices)

Section 7 Project Plan and BMP Location Map

Figure 7.1 illustrates the proposed project and the Source Control structural and Treatment BMPs that will be implemented pursuant to this WQMP. The following checklist identifies the required information that is included in the BMP map.

Included	Requirement
X	Legend, north arrow, scale
X	Show drainage arrows, and drainage areas
X	Entire property on one map (provided sufficient detail is shown)
X	Show structures to be constructed and removed
X	Show proposed and existing storm drain systems
X	Show all external hardscape surfaces such as walkways, driveways, pools, spas, patio areas etc.
X	Indicate the landscape areas and planters
X	Show nearby waterbodies by name, if available
X	Identify site outlet and/or connection to municipal storm drain system
X	Identify locations of all source control structural and treatment BMPs on the Map. Indicate the BMP location using the BMP number.
X	Differentiate/identify pervious and impervious surfaces, buildings, activity areas, etc.
NA	Identify areas of potential soil erosion (The proposed development is on a mild slope existing car sales lot that is 90% impervious).



6/14/11 JN10-108016 Bioretention PlanterBox.mxd DJ

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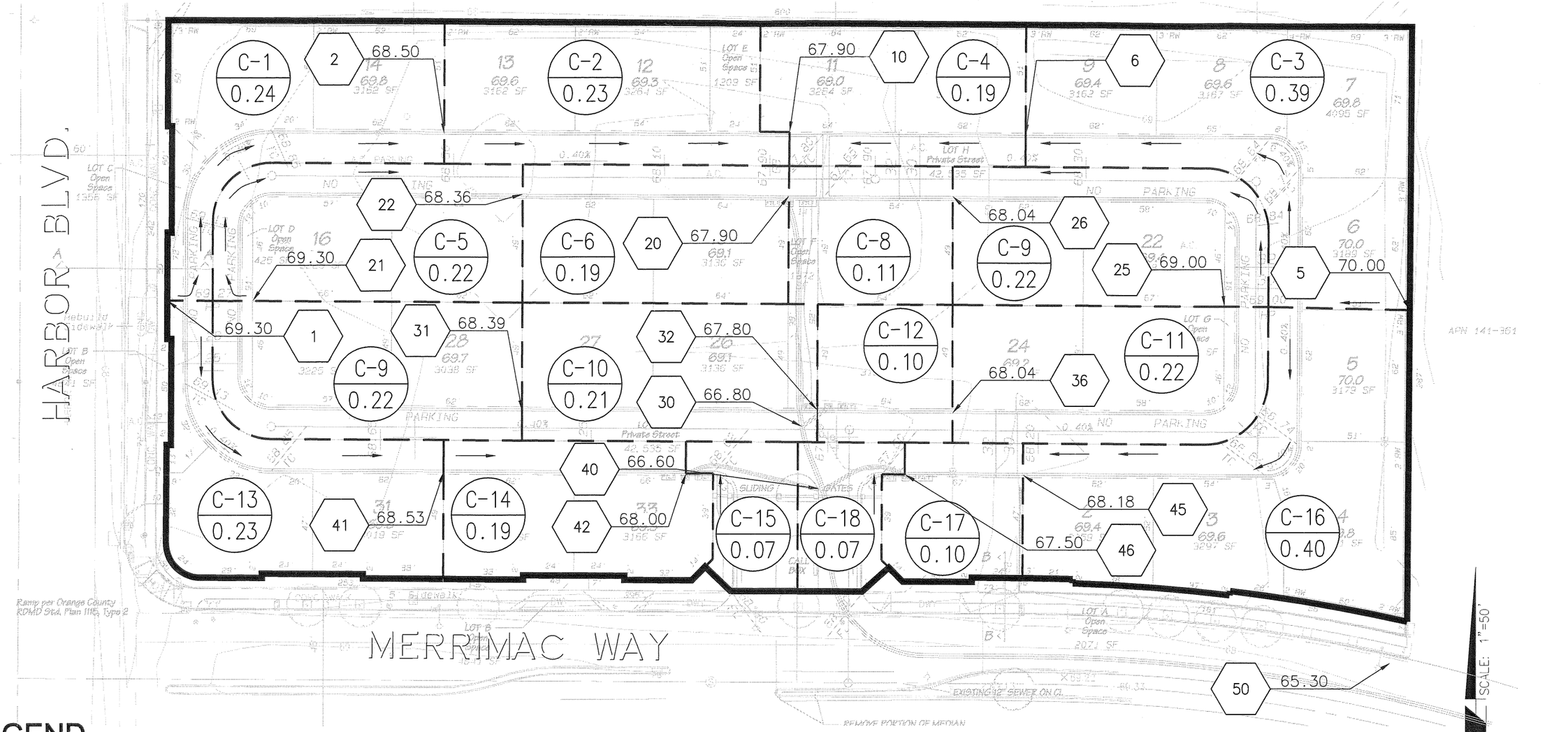
0 25 50 100 Feet

Source: Bing Imagery

HARBOR BLVD. / MERRIMAC WAY PROJECT

Tentative Tract Number 17423



LEGEND

- DRAINAGE BOUNDARY
- SUBAREA BOUNDARY
- FLOW PATH
- B-12 / 11.3 — SUBAREA DESIGNATION / AREA (ACRES)
- 1000 — HYDROLOGY NODE

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PROPOSED HYDROLOGY
EXHIBIT 5

SHEET 1 OF 1

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Section 8 Stormwater BMP Maintenance

The City does not accept stormwater structural BMPs as meeting the WQMP requirements standard, unless an Operations and Maintenance (O&M) Plan is prepared and a mechanism is in place that will ensure ongoing long-term maintenance of all structural and non-structural BMPs.

The proposed project will implement the following maintenance mechanism to ensure ongoing long-term maintenance of all structural and non-structural BMPs.

The Home Owners Association will be responsible for maintenance and operational performance of all on-site BMPs. Prior to transfer of responsibility to the HOA, the contact information is as follows:

Garrett Calacci
Waterpointe Homes
190 Newport Center Drive
Newport Beach, California 92660
949-644-8900
garrett@waterpointehomes.net

8.1 Operation and Maintenance (O&M) Plan

An O&M Plan will be prepared for the proposed project and must be approved by the City prior to construction approvals, permit close out and issuance of certificates of use and occupancy. The O&M Plan describes the designated responsible party to manage the stormwater BMP(s), employee's training program and duties, operating schedule, inspection and maintenance frequencies, routine service schedule, specific maintenance activities, copies of resource agency permits, and any other necessary activities. At a minimum, maintenance agreements shall require the inspection and servicing of all structural BMPs per manufacturer or engineering specifications. Parties responsible for the O&M plan shall retain records for at least 5 years. These documents shall be made available to the City for inspection upon request at any time.

Desig-nator. Code (e.g. N1 or SC-1)	BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Source Control Non-Structural BMPs			
N1	*Education for Property Owners, Tenants and Occupants*	To be implemented at start of occupancy	*HOA*
N2	*Activity Restrictions*	Outlined in CC&Rs	*HOA*
N3	*Common Area Landscape Management*	To be implemented at start of construction phase	*HOA*
N4	*BMP Maintenance*	Maintenance as described herein	*HOA*

N6	*Local Water Quality Permit Compliance*	To be implemented at start of construction phase	*Client*
N11	*Common Area Litter Control*	To be implemented as needed to prevent pollution	*HOA*
N14	*Drainage Facility Inspection*	o be implemented as needed to prevent pollution	*HOA*
N15	*Street Sweeping Private Streets and Parking Lots*	To be implemented weekly or per the City's maintenance schedule	*City*
Source Control Structural BMPs			
SD-10	*Site Design and Landscape Planning*	To be implemented during design phase Maintenance as described herein	*Various per table*
SD-11	*Roof Runoff Controls*	To be implemented during design and construction phases Maintained to prevent clogging See attached Roof Runoff Controls reference materials (Appendix D)	*Homeowner*
SD-12	*Efficient Irrigation*	To be implemented continually	*HOA (common areas)* *Homeowner (residence)*
SD-13	*Storm Drain System Signs*	Implemented during construction phase by Client, but inspect and maintained as needed by HOA	*HOA*
SD-21	*Alternative Building Materials*	To be implemented at start of construction	*Client*
Treatment Control BMPs			
TC-30	*Vegetated Swale*	See attached maintenance plan (Appendix D)	*Homeowner (residence)*
TC-31	*Vegetated Buffer Strip*	See attached maintenance plan (Appendix D)	*Homeowner (residence)*
TC-32	*Bioretention*	See attached maintenance plan (Appendix D)	*HOA*
TC-60	*Multiple Systems*	Refer to above BMPs	*HOA*

Required Posting

A statement requiring the above table to be laminated and posted in the primary maintenance worker assembly area(s) related to the project shall be included in the WQMP.

Required Permits

List any permits required for the implementation, operation, and maintenance of the BMPs. Possible examples are:

- Permits for connection to sanitary sewer
- Permits from California Department of Fish and Game
- Encroachment permits

If no permits are required, a statement to that effect should be made.

Forms to Record BMP Implementation, Maintenance, and Inspection

The form that will be used to record implementation, maintenance, and inspection of BMPs is attached.

WQMP Operations and Maintenance Log				
Designator Code	Date of Inspection	Date of Maintenance	Verified/ Inspected by	Comments

Appendix A. Model WQMP References

Table 7.II-2 Anticipated and Potential Pollutants Generated by Land Use Type

Priority Project Categories and/or Project Features	General Pollutant Categories							
	Suspended Solid/ Sediments	Nutrients	Heavy Metals	Pathogens (Bacteria/ Virus)	Pesticides	Oil & Grease	Toxic Organic Compounds	Trash & Debris
Detached Residential Development	E	E	N	E	E	E	N	E
Attached Residential Development	E	E	N	E	E	E(2)	N	E
Commercial/ Industrial Development	E(1)	E(1)	E(5)	E(3)	E(1)	E	E	E
Automotive Repair Shops	N	N	E	N	N	E	E	E
Restaurants	E(1)(2)	E(1)	E(2)	E	E(1)	E	N	E
Hillside Development >5,000 ft²	E	E	N	E	E	E	N	E
Parking Lots	E	E(1)	E	E(4)	E(1)	E	E	E
Streets, Highways, & Freeways	E	E (1)	E	E(4)	E(1)	E	E	E
Retail Gasoline Outlets	N	N	E	N	N	E	E	E

E = expected to be of concern

N = not expected to be of concern

(1) Expected pollutant if landscaping exists on-site, otherwise not expected.

(2) Expected pollutant if the project includes uncovered parking areas, otherwise not expected.

(3) Expected pollutant if land use involves food or animal waste products, otherwise not expected.

(4) Bacterial indicators are routinely detected in pavement runoff.

(5) Expected if outdoor storage or metal roofs, otherwise not expected.

Table 7.II-3 Summary of the 2006 and 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for Orange County

Region	Water Body	Pollutant																	
		Bacteria Indicators/ Pathogens		Metals		Nutrients		Pesticides		Toxicity		Trash		Salinity/ TDS/ Chlorides		Turbidity		Other Organics	
		2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List
Region 8 Santa Ana	Anaheim Bay			X	X			X	X	X	X							X	X
	Bolsa Chica Channel			X	X														
	Buck Gully Creek	X	X																
	Huntington Beach State Park	X																X	X
	Huntington Harbor	X	X	X	X			X	X	X	X							X	X
	Los Trancos Creek (Crystal Cove Creek)	X	X																
	Newport Bay, Lower			X		X	X	X	X	X	X							X	X
	Newport Bay, Upper (Ecological Reserve)			X	X	X	X	X	X	X	X					X	X	X	X
	San Diego Creek, Reach 1	X	X	X	X	X	X	X	X										
	San Diego Creek, Reach 2			X															
	Seal Beach	X	X															X	X
	Silverado Creek	X	X											X	X				

Table 7.II-3 Summary of the 2006 and 2010[1] 303(d) Listed Water Bodies and Associated Pollutants of Concern for Orange County (Continued)

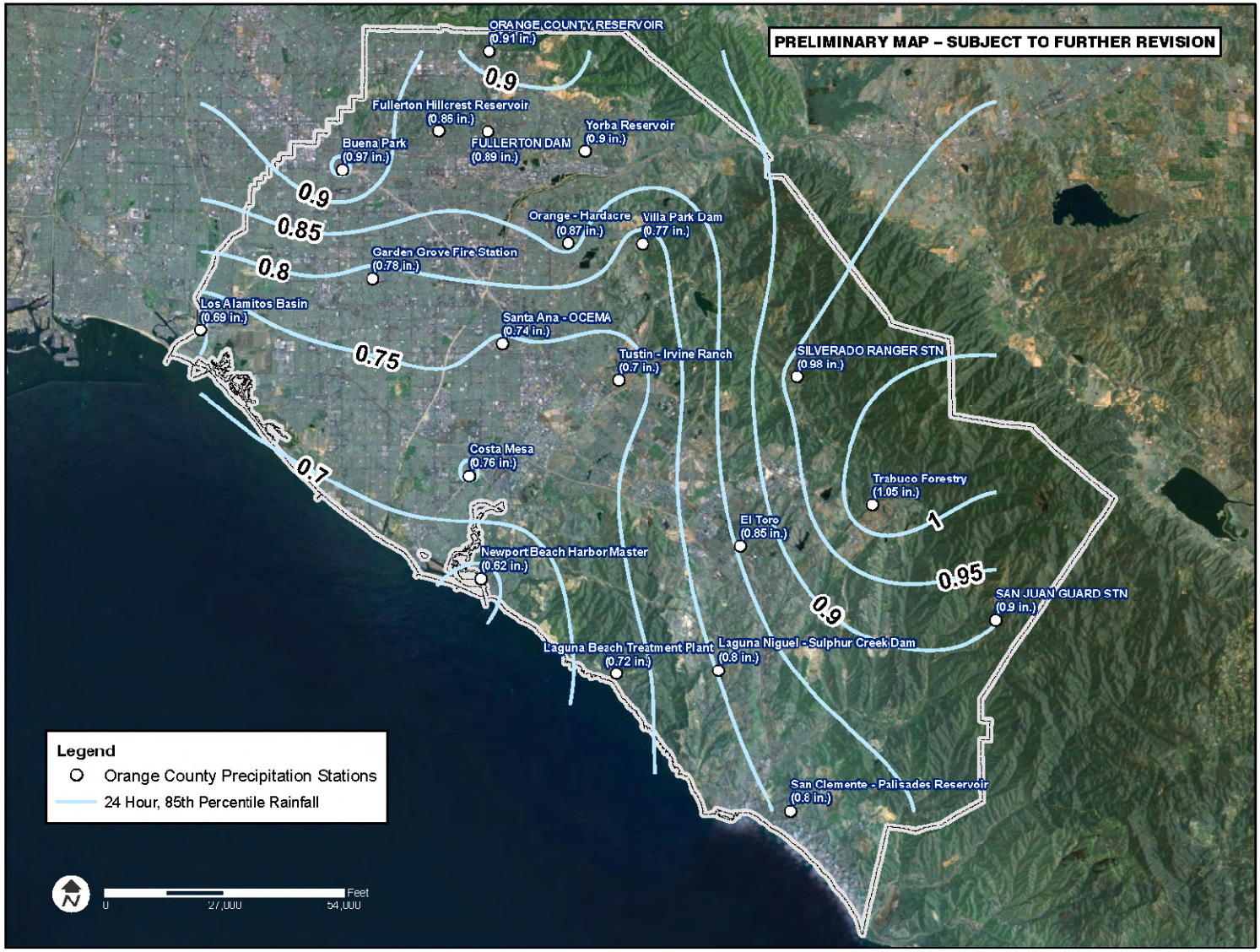
Region	Water Body	Pollutant																	
		Bacteria Indicators/ Pathogens		Metals		Nutrients		Pesticides		Toxicity		Trash		Salinity/ TDS/ Chlorides		Turbidity		Other Organics	
		2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List	2006 List	2010 List
Region 9 San Diego	Aliso Creek (Mouth)	X	X																
	Aliso Creek (20 Miles)	X	X			X	X			X	X								
	Dana Point Harbor	X	X		X						X								
	Pacific Ocean Shoreline, Aliso Beach HSA	X																	
	Pacific Ocean Shoreline, Dana Point HSA	X																	
	Pacific Ocean Shoreline, Laguna Beach HSAs	X																	
	Pacific Ocean Shoreline, Lower San Juan HSA	X	X																
	Pacific Ocean Shoreline, San Clemente HA at San Clemente City Beach, North Beach	X	X																
	Pacific Ocean Shoreline, Other San Clemente and San Joaquin Hills HAs	X																	
	Pacific Ocean Shoreline, San Mateo Canyon HAs		X																
	Prima Deshecha Creek				X	X	X									X	X		
	San Juan Creek	X	X		X		X	X			X								
	Segunda Deshecha Creek					X	X				X					X	X		

[1] 2010 303(d) list information will be updated upon approval of the final 303(d) list

Table 7.II-4 Summary of the Status of TMDLs for Waterbodies in Regions 8 and 9

Region	Water Body	Pollutant				
		Bacteria Indicators/ Pathogens	Metals	Nutrients	Pesticides	Turbidity/ Siltation
Region 8 Santa Ana	Newport Bay, Lower	Implementation Phase	Technical TMDLs	Implementation Phase	Technical TMDLs	Implementation Phase
	Newport Bay, Upper (Ecological Reserve)	Implementation Phase	Technical TMDLs	Implementation Phase	Technical TMDLs	Implementation Phase
	San Diego Creek, Reach 1		Technical TMDLs	Implementation Phase	Technical TMDLs and Implementation Phase	Implementation Phase
	San Diego Creek, Reach 2		Technical TMDLs	Implementation Phase		Implementation Phase
Region 9 San Diego	Aliso Creek (20 Miles) Pacific Ocean Shoreline, Laguna Beach HSAs	Implementation Phase				
	Dana Point Harbor Pacific Ocean Shoreline HSAs	Implementation Phase or In Progress				
	Pacific Ocean Shoreline, San Clemente HA	In Progress				
	San Juan Creek (mouth)	Implementation Phase				

Figure 6.2
Design Capture Storm Depth for Orange County (85th percentile, 24 hour Isopluvials)
Click Here for Higher Resolution Figure



Appendix B. Hydrology Study

Hydrology Technical Study
Tentative Tract 17423

City of Costa Mesa, Orange County, CA

Prepared for
City of Costa Mesa
77 Fair Drive
Costa Mesa, CA 92626
Contact: Mrs. Minoo Ashabi

Prepared by
RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Contact
Rebecca Kinney, RCE 58797
Jeff Langdon, RCE 42429

June 13, 2011
RBF JN 10-108158

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Tables

Exhibits

Appendices

1 INTRODUCTION

This study addresses the hydrologic impacts associated with the proposed development of Tentative Tract 17423 (project), located in the City of Costa Mesa, California. The City of Costa Mesa is located in the County of Orange; refer to Exhibit 1: Regional Vicinity Map. The project site is at 2626 Harbor Boulevard at the corner for Harbor Boulevard and Merrimac Way; refer to Exhibit 2: Local Vicinity Map.

The project consists of the construction of thirty-three (33) residential lots, one (1) private street, and seven (7) open space lots on approximately 3.71-acres.

This report is a technical engineering study/evaluation to be used solely to support the environmental document for the project on issues related to drainage, and surface hydrology. The level of analysis prepared is compatible with the level of planning information available.

All assessments and technical analysis in this report are in compliance with the local drainage policies and requirements for the City of Costa Mesa, Orange County, and the California Environmental Quality Act (CEQA) of 1970, as amended. The hydrology analysis has been prepared at a preliminary engineering level based upon the details of the available information for an environmental document.

1.1 History/Background

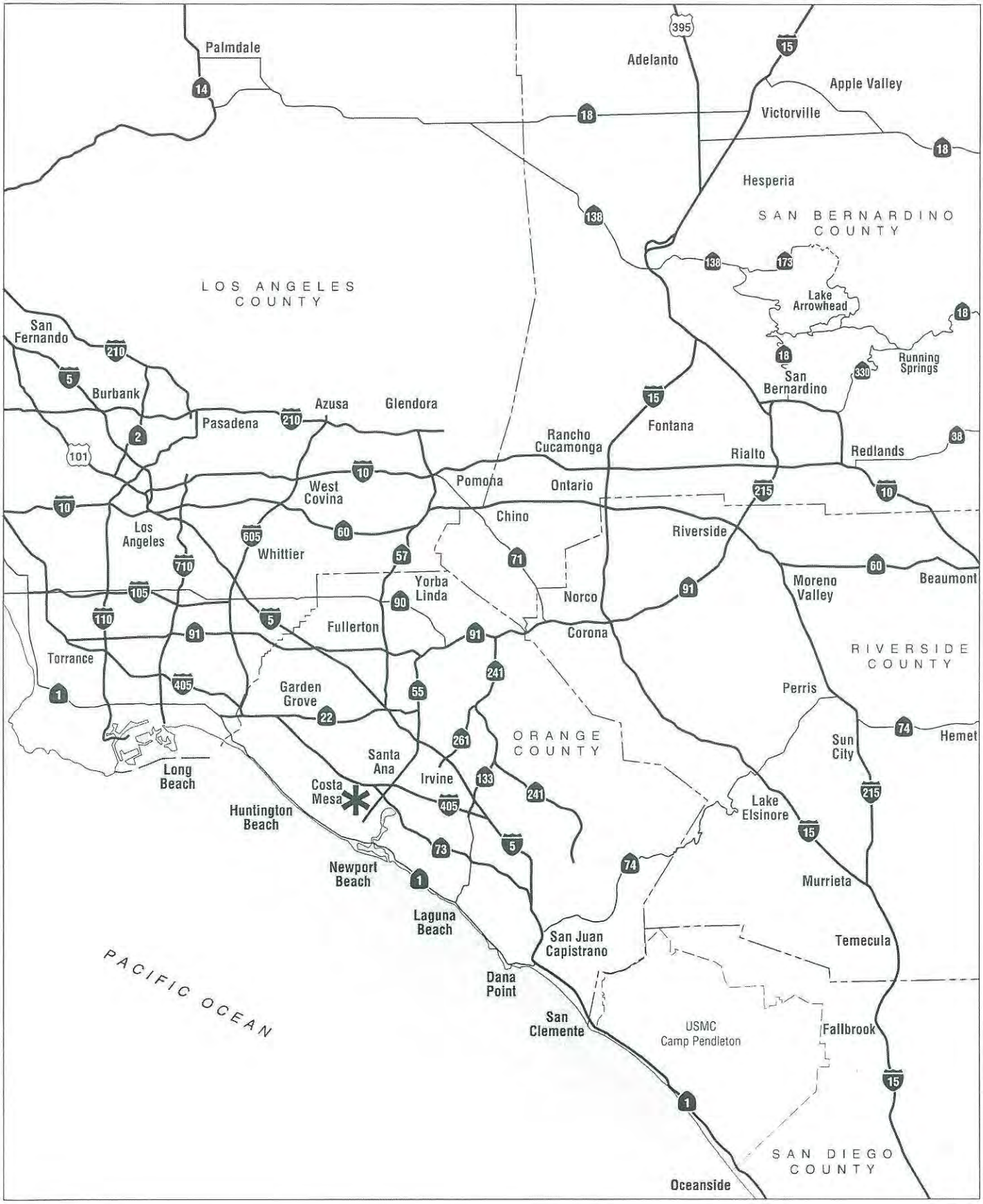
The project site is located in a highly urbanized coastal plain of Orange County. The site is south of the Santa Ana River, and is located within the Santa Ana Delhi Watershed which s tributary to the Upper Newport Bay.

1.2 Definition of Level of Significance

The purpose of this technical evaluation is to determine the impact of the proposed residential development on hydrology, and floodplains within the study area. Should the analysis determine that the proposed project significantly impacts the drainage patterns, hydrology, or floodplains, appropriate mitigation will be identified to minimize the project impacts to less than significant levels.

1.2.1 Flood Control Criteria

Federal, state, and local drainage laws and regulations govern the evaluation of impacts to surface water drainage. For this evaluation, impacts to surface water drainage would be considered significant if the project alters the drainage patterns of the site, resulting in substantial erosion, siltation, or increased run-off that would result in increased flooding in downstream facilities.



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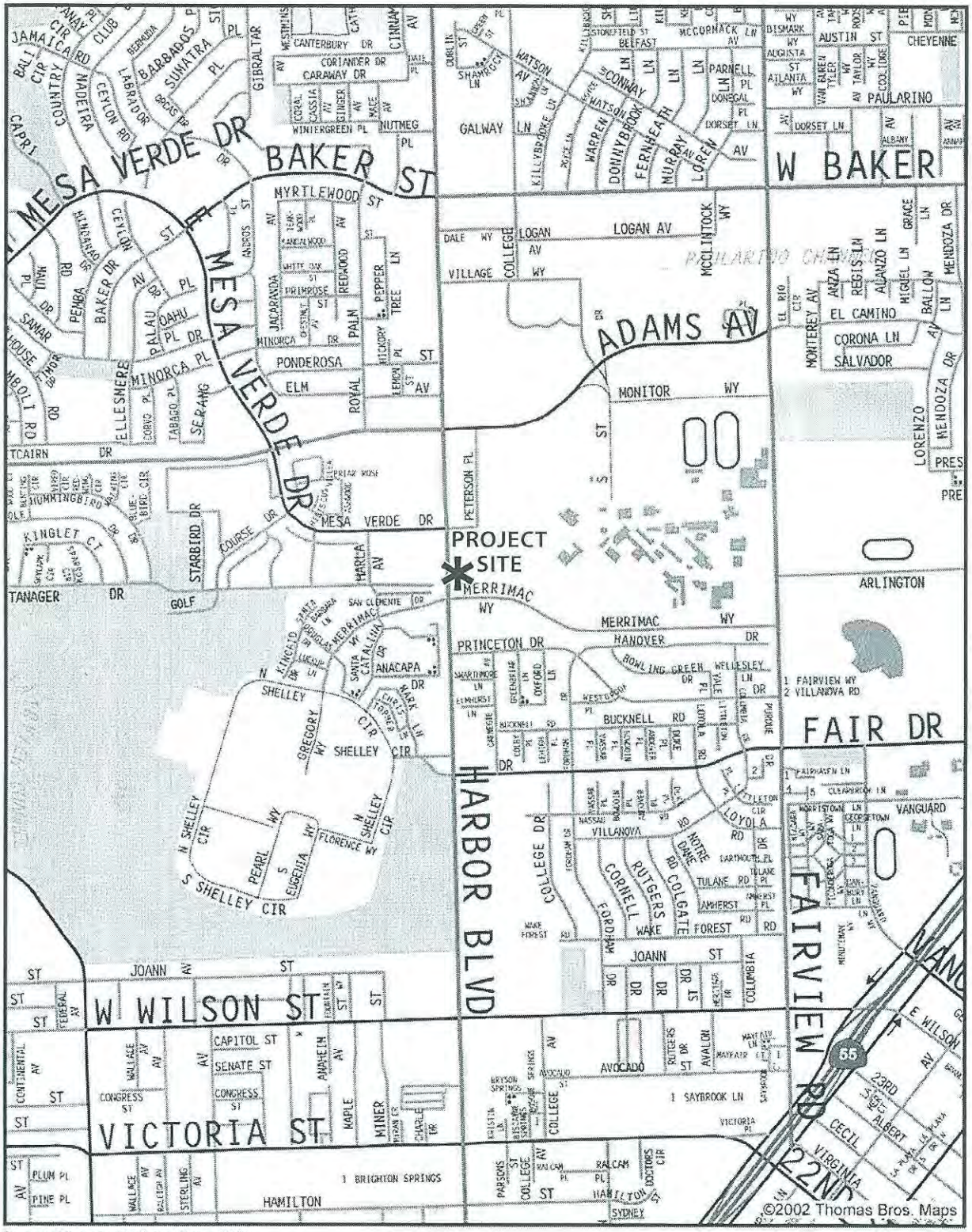
0 5 11 miles
APPROXIMATE

6/08/11 JN 10-108150

2626 HARBOR BOULEVARD
INITIAL STUDY/MITIGATED NEGATIVE DECLARATION

Regional Vicinity

Exhibit 1



Source: Thomas Brothers Maps, 2002.

NOT TO SCALE

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6/08/11 JN 10-108150

2626 HARBOR BOULEVARD
INITIAL STUDY/M TIGATED NEGATIVE DECLARATION

Local Vicinity

Exhibit 2

2 EXISTING CONDITION

This section is divided into three sub-sections: 1) existing land use; 2) hydrology; and 3) floodplains. Each sub-section describes different aspects of the existing condition of the project site.

2.1 Existing Land Use

The project site was formerly a Lincoln Mercury car dealership. Two vacant structures associated with the previous auto dealership are located on the project site. The site is comprised entirely of impervious surfaces primarily associated with the former dealership's parking lot. The project site is largely void of vegetation with the exception of a few ornamental trees along the Harbor Boulevard frontage and along the project site's western boundary.

Commercial uses (car dealerships) and a two-story multi-family housing development are located along the project site's northern boundary. Car ports and associated parking from these uses immediately abut the project. East of the project site is a three-story multi-family residential use. The development and associated surface parking, including carports, immediately abut the project.

Merrimac Way borders the project site to the immediate south. Beyond Merrimac Way is an auto dealership with associated mechanics facilities and surface parking. Multi-family residential uses with associated surface parking are also located to the south beyond Merrimac Way. Harbor Boulevard bounds the project site to the west. Beyond Harbor Boulevard is a multi-family residential development as well as Local Business (C1) uses.

For the existing hydrology condition analysis, the project site was considered commercial land use with a percent impervious of 90%.

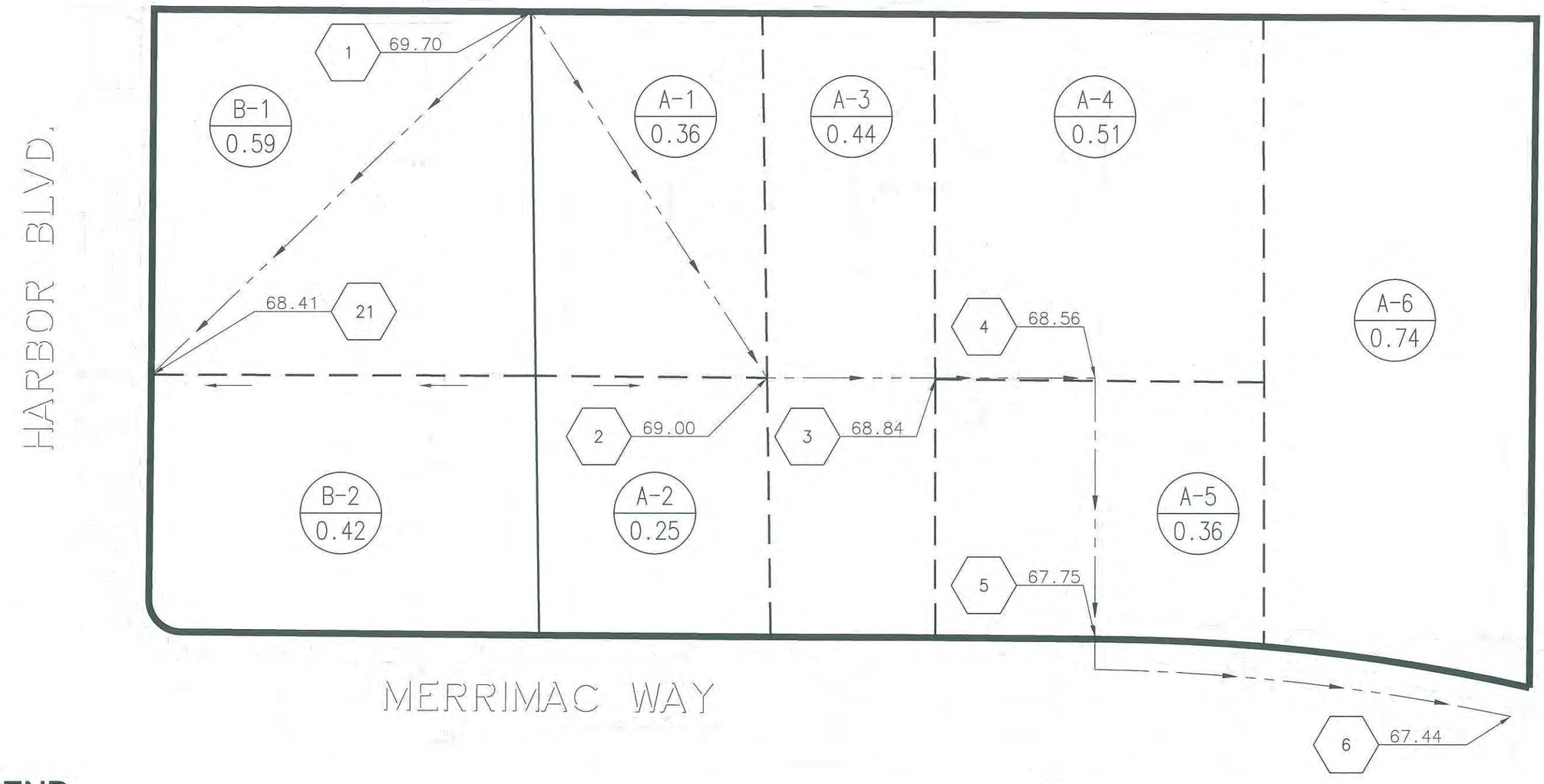
2.2 Hydrology

This sub-section describes the existing condition technical analysis. The sub-section is broken into two parts: Watershed Description and Analysis and Results.

2.2.1 Watershed Description

The existing watershed is broken up into two sub-watersheds: the area draining to Harbor Boulevard and the area draining to Merrimac Way, refer to Exhibit 3: Existing Conditions Hydrology Map. The runoff tributary to Harbor Boulevard (Watershed B) sheet flows from the parking lot to a driveway which outlets the flow onto Harbor Boulevard which eventually makes its way northeastword to F03 (Paularino Channel) which is eventually tributary to the Santa Ana Delhi Channel.

The runoff tributary to Merrimac sheet flows into a ribbon gutter, which eventually discharges to Merrimac Way through a driveway. The flow then continues eastward on Merrimac Way until it enters a catch basin which is tributary to an existing 4.5'Hx8'W RCB. The RCB is eventually tributary to E03 upstream of Pinecreek Drive.



LEGEND

- DRAINAGE BOUNDARY
- SUBAREA BOUNDARY
- FLOW PATH
- B-12 / 11.3 — SUBAREA DESIGNATION / AREA (ACRES)
- 1000 — HYDROLOGY NODE

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EXISTING HYDROLOGY
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2.2.2 Analysis and Results

For this study, the existing site was delineated based on the topography. The areas were calculated and a rational method hydrology analysis was completed in accordance with Orange County Hydrology Manual Requirements. See Table 2-1 for Existing Condition Results.

Table 2-1: Existing Condition Hydrology Summary

Sub-Watershed	Node	Area (acres)	Total 10-Year Flow Rate Exiting the Site (cfs)	Total 25-Year Flow Rate Exiting the Site (cfs)	Total 100-Year Flow Rate Exiting the Site (cfs)
A	**6**	2.67	6.12	7.37	9.53
B	**21**	1.01	2.78	3.48	4.46

For the water quality Hydrologic Conditions of Concern Analysis, a 2-year storm was analyzed for runoff flowrate, volume and time of concentration for the overall site**.**

Table 2-2: Existing Condition 2-Year Analysis Summary

Flowrate (cfs)	Volume (Acre-feet)	Time of Concentration (Minutes)
4.82	0.45	11.72

2.3 Floodplains

The published Flood Insurance Rate Maps (FIRMs) for the project site are included on Community Panel No. 06059C0266J. Refer to Exhibit 4: FEMA FIRM Map, for a location of mapped floodplains. The project is located within the FEMA Zone X (Other Flood Areas) designation. FEMA Flood Zone X (Other Flood Areas) designated areas are outside of the 0.2% annual chance floodplain. FEMA Flood Zone X is a moderate to low risk flooding area where flood insurance is available to property owners but not required.

ional Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

50 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0266J

FIRM

FLOOD INSURANCE RATE MAP

ORANGE COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 266 OF 539

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COSTA MESA, CITY OF	060216	0266	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06059C0266J

MAP REVISED
DECEMBER 3, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EXHIBIT 4: FEMA FIRM MAP

3 PROPOSED CONDITIONS

This section describes the proposed condition technical analysis. The section is broken into three sub-sections: 1) proposed land use; 2) hydrology; and 3) floodplains. Each sub-section describes different aspects of the proposed condition.

3.1 Proposed Land Use

For the proposed condition, the project site was considered one land use: 8-10 dwelling units per acres. The percent impervious for each land use was per the *County of Los Orange Hydrology Manual*; refer to Exhibit 5: Proposed Conditions Hydrology Map and Table 3-1: Proposed Land Use Summary.

Table 3-1: Proposed Land Use Summary

Sub-Watershed	Node	Total Area	
		(ac)	% Impervious
C	**50**	3.6	60%

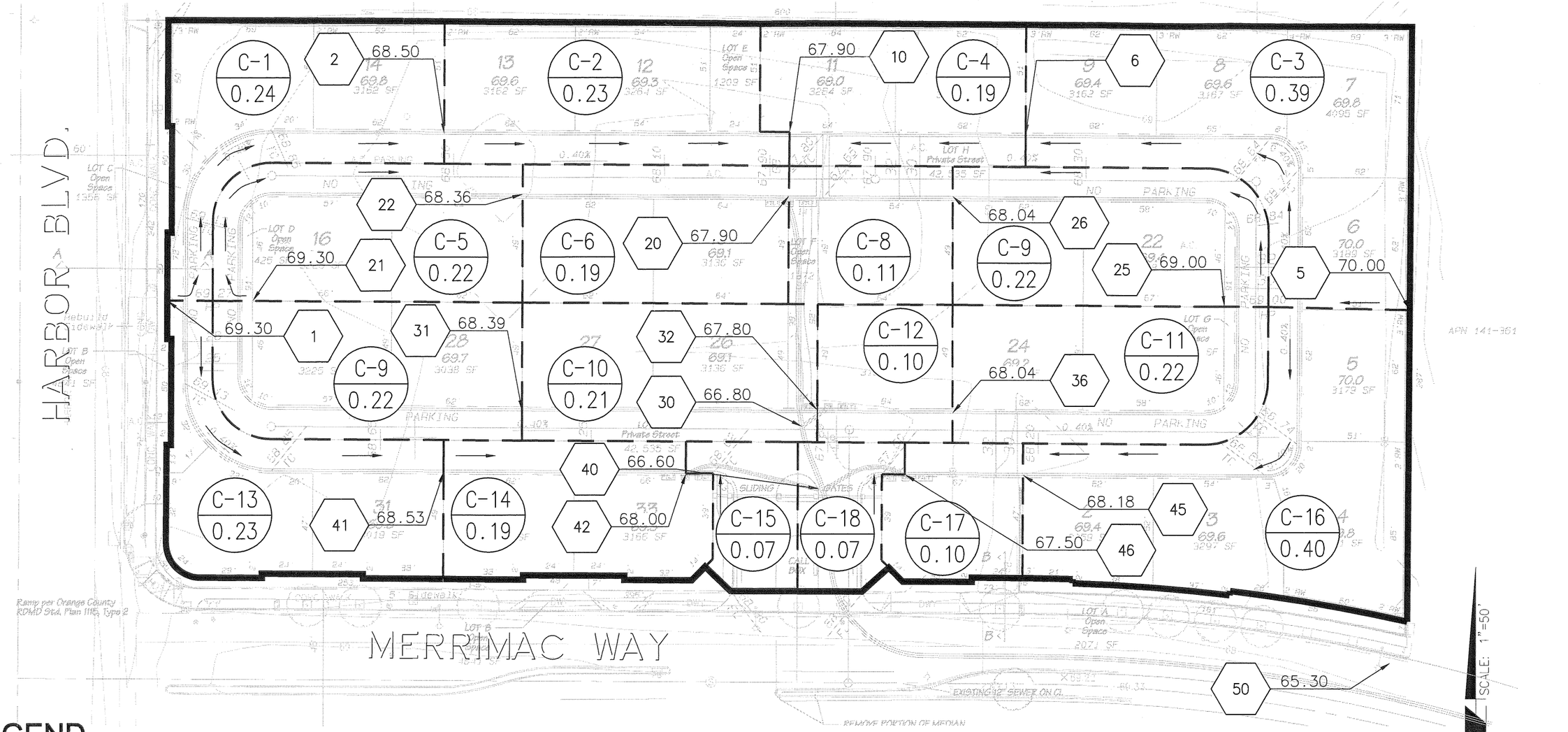
3.2 Hydrology

This sub-section is divided into two parts: 1) Watershed Description and 2) Analysis and Results.

3.2.1 Watershed Description

The proposed watershed is one Sub-watershed that is tributary to a new proposed storm drain pipe that will connect the new onsite storm drain directly to the existing 4.5'Hx8'W box under Merrimac Way (existing discharge point of Existing Condition Watershed A). The watershed tributary to the existing 4.5'Hx8'W box has increased slightly due to the combination of the existing Watershed A and B in the proposed condition (Watershed C). However, the percent impervious has been reduced from 90% to 60%.

The onsite storm drain consists of gutters, catch basins and storm drain to capture the development flow and direct it to the new storm drain extension in Merrimac Way.



LEGEND

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PROPOSED HYDROLOGY
EXHIBIT 5

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3.2.2 Analysis and Results

A proposed conditions hydrology analysis was completed for the 10-, 25-, and 100-year storms for comparison against existing conditions. The proposed condition hydrology was calculated using the Orange County Rational Method Hydrology; refer to Table 3-2: Proposed Hydrology Analysis Summary.

Table 3-2: Proposed Hydrology Analysis Summary

Sub-Watershed	Node	Area (acres)	Total 10-year Flow Rate (cfs)	Total 25-year Flow Rate (cfs)	Total 100-year Flowrate (cfs)
C	**50**	3.60	8.16	9.83	12.68

For the water quality Hydrologic Conditions of Concern Analysis, a 2-year storm was analyzed for runoff flowrate, volume and time of concentration for the overall site.

Table 3-1: Proposed Condition 2-Year Analysis Summary

Flowrate (cfs)	Volume (Acre-feet)	Time of Concentration (Minutes)
4.34	0.27	12.53

3.3 Floodplains

Since the project area is in a Zone X floodplain, which is not a special flood hazard area, no changes to the floodplain will occur as part of the proposed project.

4 IMPACTS

This section describes the proposed condition impact to the watershed. The section is broken into four sub-sections: 1) drainage; 2) hydrology: and 3) floodplains. Each sub-section describes the different impacts caused by the proposed condition.

4.1 Drainage

The proposed project would alter drainage patterns due to on-site grading; refer to Table 4-1: Comparison of Drainage Area Impacts.

Table 4-1: Comparison of Drainage Area Impacts

Sub-Watershed	Existing Conditions		Proposed Conditions		Comparison	
	Area (ac)	% Impervious	Area (ac)	% Impervious	Δ Area (ac)	Δ %Impervious
A/C	2.67	90	3.68	60	1.07	-30%
B	1.01	90	0	0	-1.07	

4.2 Hydrology

The results of the impact analysis show that the change in drainage patterns onsite have caused a minor increase in flow to the proposed storm drain in Merrimac. However, overall the flow from the site is decreased to the Paularino Channel. Table 4-2: Comparison of Hydrology shows the results.

Table 4-2: Comparison Hydrology

Sub-Watershed	10-Year Storm			25-Year Storm			100-Year Storm		
	Existing Flowrate (cfs)	Proposed Flowrate (cfs)	Δ Flowrate	Existing Flowrate (cfs)	Proposed Flowrate (cfs)	Δ Flowrate	Existing Flowrate (cfs)	Proposed Flowrate (cfs)	Δ Flowrate
A/C	6.12	8.16	+2.04	7.37	9.83	+2.46	9.53	12.68	+3.15
B	2.78	0	-2.78	3.48	0	-3.46	4.46	0	-4.46
Total	8.90	8.16	-0.74	10.85	9.83	-1.0	13.99	12.68	-1.31

The results of the 2-year impact analysis show decreases in flowrate and volume, with an increase in Time of Concentration. The proposed land use would bring the hydrology of the 3.68 acres closer to a natural condition due to the increase in pervious area. The impacts of this change on the Santa Ana Delhi will be negligible as the project only represents 0.033% (3.68/11,071 acres) of the watershed.

Table 4-3: 2-year Comparison Hydrology

Parameter	Existing	Proposed	Δ
Flowrate (cfs)	4.82	4.34	-0.48
Volume (acre-feet)	0.45	0.27	-.0.18
Time of Concentration (min)	11.72	12.53	+0.81

4.3 Floodplains

There are no mapped special flood hazard areas on-site; therefore, there is no impact.

5 PROPOSED MITIGATION

This section describes the mitigation measures required to prevent the proposed project impacts to the watershed. The section is broken into four sub-sections: 1) drainage; 2) hydrology; and 3) floodplains.

5.1 Drainage

Mitigation measures for drainage are listed below:

- Prepare a detailed hydrology study to accurately identify project impacts.
- A new storm drain between the project site and the existing 4.5'H x8W RCB shall be analyzed, designed and constructed.
- All storm drain facilities shall be designed for 25-year storm event protection.

Completion of these drainage mitigation measures would reduce impacts to a less than significant level.

5.2 Hydrology

Refer to mitigation measures outlines in Section 5.1. Completion of these mitigation measures would reduce flooding impacts to less than significant level.

5.3 Floodplain

No mitigation is required.

6 REFERENCES

Orange County Department of Public Works. *Orange County Hydrology Manual.* October 1986.

County of Orange. *Hydrology Report Santa Ana-Delhi Channel - Facility F01Entire Draiange System.* January 1996.

APPENDIX A: EXISTING CONDITION 10-, 25- AND 100-YEAR ANALYSIS

APPENDIX B: PROPOSED CONDITION 10-, 25-, AND 100-YEAR ANALYSIS

APPENDIX C: 2-YEAR ANALYSIS FOR EXISTING AND PROPOSED

Appendix C. Educational Material

The Ocean Begins at Your Front Door

Follow these simple steps to help reduce water pollution:

Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

Common Pollutants

Home Maintenance

- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

Lawn and Garden

- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

Automobile

- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

The Ocean Begins at Your Front Door

Never allow pollutants to enter the street, gutter or storm drain!

Did You Know?

- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called “non-point source” pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

Where Does It Go?

- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.

The Effect on the Ocean

Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.

For More Information

California Environmental Protection Agency
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

Earth 911 - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

Health Care Agency's Ocean and Bay Water Closure and Posting Hotline
(714) 433-6400 or visit www.ocbeachinfo.com

Integrated Waste Management Dept. of Orange County (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

O.C. Agriculture Commissioner
(714) 447-7100 or visit www.ocagcomm.com

Stormwater Best Management Practice Handbook
Visit www.cabmphandbooks.com

UC Master Gardener Hotline
(714) 708-1646 or visit www.uccemg.com

The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

Orange County Stormwater Program

Aliso Viejo	(949)	425-2535
Anaheim Public Works Operations	(714)	765-6860
Brea Engineering	(714)	990-7666
Buena Park Public Works	(714)	562-3655
Costa Mesa Public Services	(714)	754-5323
Cypress Public Works	(714)	229-6740
Dana Point Public Works	(949)	248-3584
Fountain Valley Public Works	(714)	593-4441
Fullerton Engineering Dept.	(714)	738-6853
Garden Grove Public Works	(714)	741-5956
Huntington Beach Public Works	(714)	536-5431
Irvine Public Works	(949)	724-6315
La Habra Public Services	(562)	905-9792
La Palma Public Works	(714)	690-3310
Laguna Beach Water Quality	(949)	497-0378
Laguna Hills Public Services	(949)	707-2650
Laguna Niguel Public Works	(949)	362-4337
Laguna Woods Public Works	(949)	639-0500
Lake Forest Public Works	(949)	461-3480
Los Alamitos Community Dev.	(562)	431-3538
Mission Viejo Public Works	(949)	470-3056
Newport Beach, Code & Water Quality Enforcement	(949)	644-3215
Orange Public Works	(714)	532-6480
Placentia Public Works	(714)	993-8245
Rancho Santa Margarita	(949)	635-1800
San Clemente Environmental Programs	(949)	361-6143
San Juan Capistrano Engineering	(949)	234-4413
Santa Ana Public Works	(714)	647-3380
Seal Beach Engineering	(562)	431-2527 x317
Stanton Public Works	(714)	379-9222 x204
Tustin Public Works/Engineering	(714)	573-3150
Villa Park Engineering	(714)	998-1500
Westminster Public Works/Engineering	(714)	898-3311 x446
Yorba Linda Engineering	(714)	961-7138
Orange County Stormwater Program	(877)	897-7455

Orange County 24-Hour
Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

On-line Water Pollution Problem Reporting Form
w w w . o c w a t e r s h e d s . c o m

Printed on Recycled Paper

Appendix D. BMP References

Bioretention TC-32

Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

☑	Sediment	■
☑	Nutrients	▲
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

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be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft^2 of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately

aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural

soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

References and Sources of Additional Information

Coffman, L.S., R. Goo and R. Frederick, 1999: Low impact development: an innovative alternative approach to stormwater management. Proceedings of the 26th Annual Water Resources Planning and Management Conference ASCE, June 6-9, Tempe, Arizona.

Davis, A.P., Shokouhian, M., Sharma, H. and Minami, C., "Laboratory Study of Biological Retention (Bioretention) for Urban Stormwater Management," *Water Environ. Res.*, 73(1), 5-14 (2001).

Davis, A.P., Shokouhian, M., Sharma, H., Minami, C., and Winogradoff, D. "Water Quality Improvement through Bioretention: Lead, Copper, and Zinc," *Water Environ. Res.*, accepted for publication, August 2002.

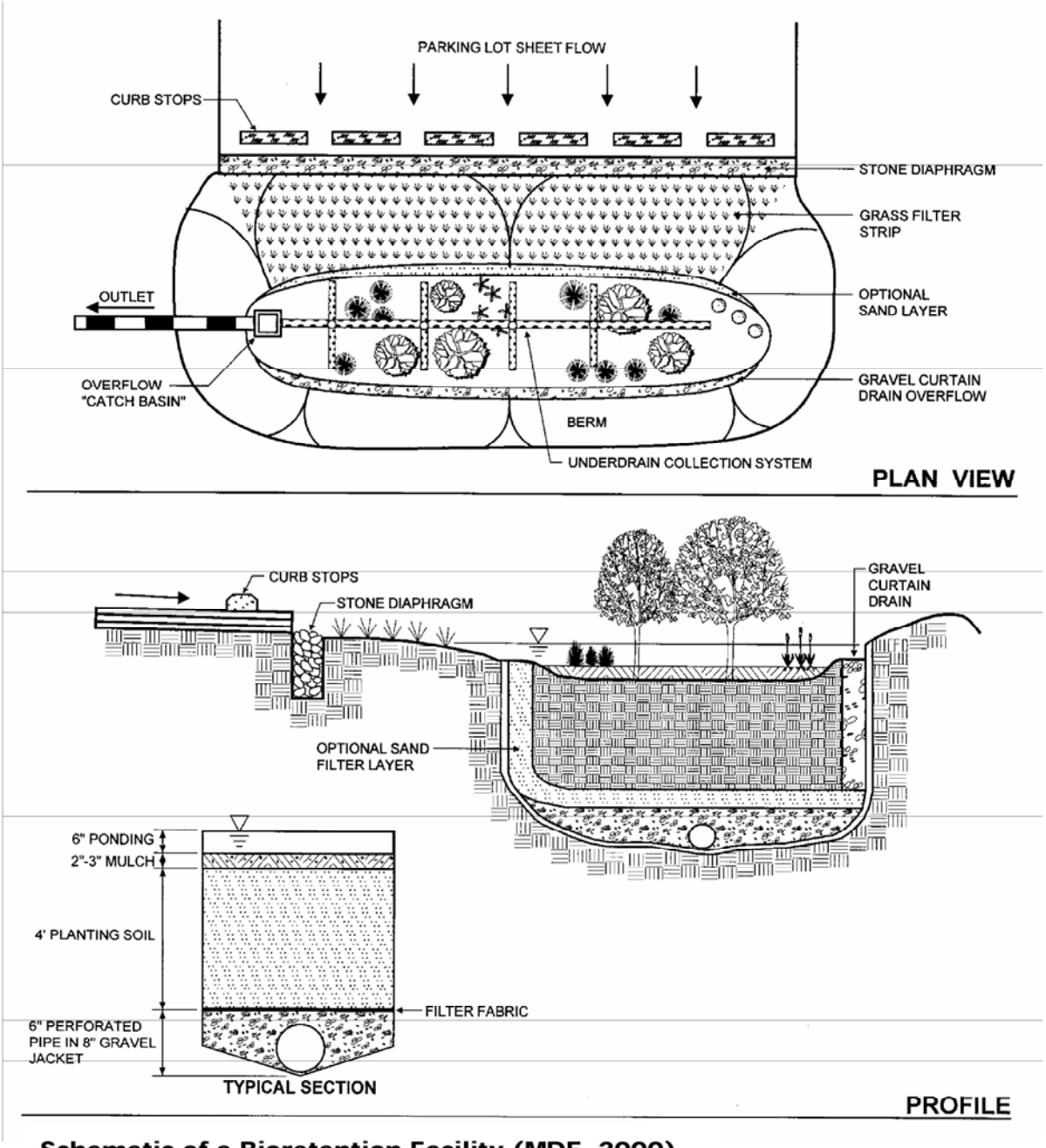
Kim, H., Seagren, E.A., and Davis, A.P., "Engineered Bioretention for Removal of Nitrate from Stormwater Runoff," *WEFTEC 2000 Conference Proceedings on CDROM Research Symposium, Nitrogen Removal*, Session 19, Anaheim CA, October 2000.

Hsieh, C.-h. and Davis, A.P. "Engineering Bioretention for Treatment of Urban Stormwater Runoff," *Watersheds 2002, Proceedings on CDROM Research Symposium*, Session 15, Ft. Lauderdale, FL, Feb. 2002.

Prince George's County Department of Environmental Resources (PGDER), 1993. Design Manual for Use of *Bioretention in Stormwater Management*. Division of Environmental Management, Watershed Protection Branch. Landover, MD.

U.S. EPA Office of Water, 1999. Stormwater Technology Fact Sheet: Bioretention. EPA 832-F-99-012.

Weinstein, N. Davis, A.P. and Veeramachaneni, R. "Low Impact Development (LID) Stormwater Management Approach for the Control of Diffuse Pollution from Urban Roadways," *5th International Conference Diffuse/Nonpoint Pollution and Watershed Management Proceedings*, C.S. Melching and Emre Alp, Eds. 2001 International Water Association



Schematic of a Bioretention Facility (MDE, 2000)